Supplementary Data 1

Logic Model of the two-tiered developmental screening programme development

**Resources/ Inputs**
- Multidisciplinary team: Polyclinic (Nurse, Doctors, IT), KK Hospital (Paediatricians, Psychiatrist, Research), Marketing
- Infrastructure: clinic spaces
- Screening Tool acquisition
- Training materials
- Equipment: laptops
- Database license

**Activities**
- Team building
  - Conduct monthly meeting
- Site visit & space planning
- Develop training materials
  - Conduct training of nurses to use screening tools/masurement
  - Co-develop screening & referral workflows
- Conduct 3-month pilot run
- Determine data to be captured
  - Build database (REDCap)
  - Build EMR algorithm for data capture (eHINTS)
  - Set up data agreement

**Outputs (Process indicators)**
- Collaborative culture: monthly multidisciplinary team meetings
- Improved knowledge and skills of polyclinic nurses
- Dyad-centered care
- QI culture: PDSA cycles
- Improved collaboration between tertiary care, primary care and community care

**Outcomes (Intermediate)**
- Improved pickup rates for developmental delay through screening
- Seamless referral workflow between primary and tertiary care
- Empowered parents through anticipatory guidance and knowledge
- Improved providers’ satisfaction

**Impact (Long term)**
- Inter-professional collaborative care team
- Improved maternal & child health through prevention and early detection
- Reduce healthcare costs by optimizing human potential

**Situation**
Late detection of developmental delays
### Supplementary Data 2

#### Summary of Developmental Screening Tools

<table>
<thead>
<tr>
<th>Screening Tool</th>
<th>Developmental Domains tested</th>
<th>Age Range</th>
<th>No. of items</th>
<th>Length of test</th>
<th>Method of Administration</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASQ</strong></td>
<td>Ages and Stages Questionnaires: Fine motor, gross motor, communication, problem solving, personal-social</td>
<td>1-66 months</td>
<td>30</td>
<td>10-15 minutes</td>
<td>Parent-completed</td>
<td>86</td>
<td>85</td>
</tr>
<tr>
<td><strong>PEDS</strong></td>
<td>Parents' Evaluation of Developmental Status: Global/cognitive, expressive language, receptive language, behavior, social-emotional, school, self-help, fine motor, gross motor, other/general health concerns</td>
<td>0-95 months</td>
<td>10</td>
<td>2 minutes</td>
<td>Parent-completed</td>
<td>74-80</td>
<td>70-80</td>
</tr>
<tr>
<td><strong>PEDS-DM</strong></td>
<td>Parents' Evaluation of Developmental Status - Developmental Milestones: Fine motor, gross motor, self-help, receptive language, expressive language, social-emotional (reading and math for older children)</td>
<td>0-95 months</td>
<td>6-8</td>
<td>5 minutes</td>
<td>Parent-completed</td>
<td>70</td>
<td>77-93</td>
</tr>
<tr>
<td><strong>DDST-II</strong></td>
<td>Denver Developmental Screening Test- II: Gross motor, fine motor/adaptive skills, personal/social, language</td>
<td>0-72 months</td>
<td>125</td>
<td>20-30 minutes</td>
<td>Healthcare professionals</td>
<td>56-83</td>
<td>43-80</td>
</tr>
</tbody>
</table>

Source from 20, 30
Supplementary Data 3

Novel two-tiered developmental screening workflow (Prospective cohort)

All children at ages 9, 18 and 30 months who came for developmental assessment at the primary care centre

**TIER 1 screening tools**: PEDS¹ and PEDS-DM²

**Tier 1 Screened Negative**

PEDS: ≤ 1 predictive concern AND PEDS-DM: pass all domains

**Overall screened negative**

Not Referred for specialist assessment

**Tier 1 Screened Positive**

PEDS: ≥ 1 predictive concern AND PEDS-DM: fail in any domain

PEDS: ≥ 2 predictive concerns OR PEDS-DM: ≥ 3 fail domains

**TIER 2 Screening Tool**: ASQ³

**Tier 2 Screened Negative**

ASQ: pass

Not Referred for specialist assessment

**Tier 2 Screened Positive**

ASQ: fail in any domain

**Overall screened positive**

Referred for specialist assessment

¹PEDS: Parents’ Evaluation of Developmental Status
²PEDS-DM: Parents’ Evaluation of Developmental Status-Developmental Milestones
³ASQ: Ages and Stages Questionnaire
Supplementary Data 4

Run Charts for screening rate at 9 months and at 18 months

Screening Rate of two-tiered programme (9 Months)

Screening Rate of two-tiered programme (18 months)
Supplementary Data 5

Run Charts for screening time - Time taken in minutes for nurses to perform the two-tiered screening at 9 month (A) and at 18 months (B). Dotted line in each graph depicts the average screening time trend over the screening period from Jul-Dec 2019.
Supplementary Data 6

Summary Statistics of two-tiered programme for 9 month

Total number 9-months children screened in the **prospective cohort** using two-tiered developmental screening program

Number of children referred for specialist assessment

Number of children who presented for specialist assessment

Number of children with a final developmental delay diagnosis

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Total number of 0-1 year old children screened in the **retrospective cohort** using standard of care screening program

Number of children referred for specialist assessment

Number of children who presented for specialist assessment

Number of children with a final developmental delay diagnosis

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- **Total number of 9-months children screened in the prospective cohort using two-tiered developmental screening program**: 972
- **Number of children referred for specialist assessment**: 4
- **Number of children who presented for specialist assessment**: 2
- **Number of children with a final developmental delay diagnosis**: 2
- **Percentage who were screened positive out of the prospective cohort**: 0.7%
- **Percentage of the prospective cohort who presented at the specialist**: 0.2%
- **Percentage of children presenting at the specialist who had a final developmental delay diagnosis**: 100%

- **Total number of 0-1 year old children screened in the retrospective cohort using standard of care screening program**: 3085
- **Number of children referred for specialist assessment**: 53
- **Number of children who presented for specialist assessment**: 0
- **Number of children with a final developmental delay diagnosis**: 0
- **Percentage of the retrospective cohort who were referred**: 1.7%
- **Percentage of the prospective cohort who were referred**: 0.4%
**Supplementary Data 7**

Summary of prospective cohort's demographic characteristic against referral status to a specialist (Referred versus Not Referred)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Missed (%)</th>
<th>Univariate Relative Risk (95%CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male/Female</td>
<td>59.0/57.9</td>
<td>1.02 (0.64, 1.62)</td>
</tr>
<tr>
<td>Race</td>
<td>Chinese/Non-Chinese</td>
<td>54.3/65.2</td>
<td>0.83 (0.54, 1.27)</td>
</tr>
<tr>
<td>Income Status</td>
<td>Low Income/Normal Income</td>
<td>61.7/40.0</td>
<td>1.54 (0.70, 3.41)</td>
</tr>
<tr>
<td>Maternal education</td>
<td>Degree/No Degree</td>
<td>53.9/64.3</td>
<td>0.83 (0.53, 1.31)</td>
</tr>
<tr>
<td>Birthweight</td>
<td>Low/Normal Birthweight</td>
<td>71.4/56.9</td>
<td>1.26 (0.74, 2.13)</td>
</tr>
<tr>
<td>Gestational age</td>
<td>Preterm/Term</td>
<td>75.0/56.0</td>
<td>1.34 (0.84, 2.14)</td>
</tr>
</tbody>
</table>

NOTE: No variables were eligible at p <0.20 as candidates in multiple stepwise logistic regression.
## Supplementary Data 8

Summary of prospective cohort’s demographic characteristics against specialist appointment status (presented versus missed appointment)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Appointment Missed (%)</th>
<th>Relative Risk 95%CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender Male/Female</td>
<td>59.0/57.9</td>
<td>1.02 (0.64, 1.62)</td>
<td>1.00</td>
</tr>
<tr>
<td>Race Chinese/Non-Chinese</td>
<td>54.3/65.2</td>
<td>0.83 (0.54, 1.27)</td>
<td>0.43</td>
</tr>
<tr>
<td>Income Status Low Income/Normal Income</td>
<td>61.7/40.0</td>
<td>1.54 (0.70, 3.41)</td>
<td>0.29</td>
</tr>
<tr>
<td>Maternal education Degree/No Degree</td>
<td>53.9/64.3</td>
<td>0.83 (0.53, 1.31)</td>
<td>0.58</td>
</tr>
<tr>
<td>Birthweight Low/Normal Birthweight</td>
<td>71.4/56.9</td>
<td>1.26 (0.74, 2.13)</td>
<td>0.69</td>
</tr>
<tr>
<td>Gestational age Preterm/Term</td>
<td>75.0/56.0</td>
<td>1.34 (0.84, 2.14)</td>
<td>0.45</td>
</tr>
</tbody>
</table>

NOTE: No variables were eligible at p <0.20 as candidates in multiple stepwise logistic regression.
Supplementary Data 9

Proportions of primary developmental delay diagnoses between the prospective and retrospective cohorts

**Prospective cohort (2019)**
Primary Diagnosis Distribution

- Developmental language disorder, Developmental Speech disorder: 6%
- Pervasive developmental disorder: 16%
- Global developmental delay: 19%
- Developmental disorder of motor function, Developmental behavior and emotional disorder: 59%

**Retrospective cohort (2018)**
Primary Diagnosis Distribution

- Developmental language disorder, Developmental Speech disorder: 6%
- Pervasive developmental disorder: 41%
- Global developmental delay: 13%
- Developmental disorder of motor function, Developmental behavior and emotional disorder: 40%