

1 **Acceptance and feasibility of school-based seasonal influenza vaccination in Singapore: A**
2 **qualitative study**

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24 **Abstract**

25 **Introduction**

26 Influenza is a major cause of disease in children. School-based seasonal influenza vaccination can
27 be a cost-effective tool to improve vaccine uptake among children, and can bring substantial
28 health and economic benefits to the broader community. The acceptance and feasibility of school-
29 based influenza vaccination are likely to be highly context-specific, but limited data exist from
30 tropical settings with year-round influenza transmission. We conducted a qualitative study to
31 assess acceptability and feasibility of a school-based seasonal influenza vaccination programme
32 in Singapore.

33 **Methods**

34 We conducted qualitative in-depth interviews with key stakeholders, including healthcare
35 professionals, representatives of relevant ministries, preschool principals and parents to
36 understand their perspectives on a proposed school-based seasonal influenza vaccination
37 programme. Interviews were transcribed verbatim and analysed using thematic analysis.

38 **Results**

39 We conducted 40 interviews. Although preschool-aged children are currently the recommended
40 age group for vaccination, stakeholders suggested introducing the programme in primary and/or
41 secondary schools, where existing vaccination infrastructure would facilitate delivery. However,
42 more comprehensive evidence on the local influenza burden and transmission patterns among
43 children is required to develop an evidence-based, locally relevant rationale for a school-based
44 vaccination programme and effectively engage policy-makers, school staff, and parents. Extensive,
45 age-appropriate public education and awareness campaigns would increase the acceptability of
46 the programme among stakeholders. Stakeholders indicated that an opt-out programme with free
47 or subsidised vaccination would be the most likely to achieve high vaccine coverage and make
48 access to vaccination more equitable.

49 **Conclusions**

50 Overall, participants were supportive of a free or subsidised school-based influenza vaccination
51 programme in primary and/or secondary schools, although children in this age group are not
52 currently a recommended group for vaccination. However, a better informed, evidence-based
53 rationale to estimate the programme's impact in Singapore is currently lacking. Extensive, age-
54 appropriate public education and awareness campaigns will help ensure full support across key
55 stakeholder groups.

56

57 **Keywords:** influenza, influenza vaccine, school-based vaccination

58

59 **Abbreviations**

60 SIVP School-based influenza vaccination programme

61 IDI In-depth interview

62 MoH Ministry of Health

63 HPB Health Promotion Board

64 IDS Infectious Disease Specialist

65 PubPD Public hospital Paediatrician

66 PriPD Private Paediatrician

67 GP Private General Practitioner

68 PY Polyclinic doctor

69 PP Preschool Principal

70 Par Parent of child aged 18 months to 7 years

71 **Introduction**

72 Influenza causes an estimated 9.5 million hospitalisations and 81 million hospitalisation days
73 worldwide each year [1]. Young children are a particularly vulnerable group, because they have
74 lower levels of immunological protection and high levels of contact with other potentially
75 infectious children [2]. The World Health Organization currently recommends annual vaccination
76 of children aged 6-59 months [3]. Data from high and middle-income countries show that
77 seasonal influenza vaccination of preschool- and school-aged children can effectively reduce the
78 incidence of influenza among vaccines [4–10], and confer indirect protection to unvaccinated
79 individuals in the community [11,12].

80 Studies investigating the acceptance of seasonal school-based influenza vaccination programmes
81 (SIVPs), primarily conducted among parents, have identified numerous perceived benefits of
82 such programmes, including greater convenience [13–15], increased vaccine access [15,16],
83 reduced student and teacher absenteeism and associated costs [13–15], opportunities to
84 incorporate health education into teaching [15], and broader benefits such as better pandemic
85 preparedness [15]. Studies have also identified perceived harms and challenges of SIVPs,
86 including the potential for side effects [13,14], lack of confidence in the school as an environment
87 to receive vaccination [14], disruption to teaching time [14,15], and inadequate information
88 about vaccination programmes [15].

89 In Singapore, influenza transmission occurs year-round, with two peaks of increased activity
90 coinciding with the Northern and Southern hemisphere influenza seasons [17]. Virological
91 surveillance indicates that a large proportion of acute respiratory illnesses seen at primary care
92 facilities is caused by influenza [17]. Since 2014, Singaporean Citizens and Permanent Residents
93 in influenza high-risk groups can claim for the influenza vaccine using Medisave, a mandatory
94 medical savings scheme. However, coverage of influenza vaccine among high-risk groups, such as
95 children [18] and elderly [19] is low ($\leq 15\%$).

96 Introduction of a seasonal SIVP could bring substantial direct and indirect health and economic
97 benefits in Singapore. Potential challenges related to the associated logistics, cost and public
98 acceptance of such a programme, which are likely to be highly specific to the local context, have
99 not been studied. This study assessed stakeholder perceptions of the feasibility and acceptability
100 of a seasonal SIVP in Singapore.

101 **Methods**

102 *Recruitment*

103 Between May 2017 and November 2018, we recruited representatives from different stakeholder
104 groups with an interest in childhood vaccination in Singapore. Among healthcare professionals,
105 we interviewed private general practitioners (GPs), polyclinic doctors, paediatricians and
106 infectious disease specialists. We also included representatives of the Health Promotion Board
107 (HPB), a government agency responsible for delivery of routine immunisations in primary
108 schools, and the Ministry of Health (MoH), as well as preschool principals and parents of children
109 aged 18 months to seven years. Parents were eligible to participate if they were aged 21 years
110 and above and if they were the main health decision-maker for their child. We excluded parents
111 who were not able to complete the interview in English, and those whose children had a history
112 of known serious allergic reaction to the influenza vaccine.

113 Potential interviewees from healthcare and government institutions were recruited through an
114 invitation sent to their official e-mail addresses describing the study's aims and methods. Parents
115 and preschool principals were sampled through convenient sampling from participants in a
116 prospective surveillance study of respiratory infections in child care centres in Singapore [20],
117 who had previously consented to being re-contacted for related studies.

118 *In-depth interviews*

119 In order to gain a detailed understanding of each individual participant's perspectives and
120 preferences, we opted for in-person in-depth interviews (IDIs). The IDIs explored participants'
121 attitudes and practices related to influenza and the seasonal influenza vaccine, and elicited their

122 views about the feasibility and acceptability of a proposed SIVP. The IDI guide was tailored to
123 individual stakeholder groups. For example, MoH representatives were asked to elaborate more
124 on issues of cost-effectiveness, while preschool principals were asked to expand on issues around
125 logistics or child well-being.

126 Before commencing the IDI, a trained interviewer answered all questions from participants and
127 audio-recorded their verbal consent to take part in the study. Interviewers posed probing questions
128 until a full understanding of each participant's perspective was reached. Each IDI took approximately
129 20-45 minutes to complete and was audio-recorded. A note-taker took detailed notes throughout
130 the interview. Parents were also reimbursed for their time with a S\$50 voucher and given an
131 information pamphlet on influenza and the seasonal influenza vaccine.

132 *Sample size*

133 We aimed to interview up to 50 participants from different stakeholder groups. The target sample
134 size was based on the inclusion of local infectious disease specialists and relevant representatives
135 from government institutions, and a predicted thematic saturation of approximately 10-12
136 interviews in each group among healthcare professionals, preschool principals, and parents [21],
137 with some allowance for extra interviews if saturation was not reached [22]. Within each of these
138 interviewee group, data saturation was considered achieved when no new themes emerged
139 during the IDIs and the core meaning of existing codes remained unaltered [23,24].

140 *Data analysis*

141 IDIs were transcribed verbatim and analysed by thematic analysis using nVivo 11 software [25].
142 Potentially identifying data was removed. Two investigators (VO and SS) independently coded
143 three transcripts and reached consensus on the codebook. Discrepancies were resolved through
144 discussion with a third investigator (GK). One investigator (VO) subsequently coded the
145 remaining transcripts. Emerging themes were compared within and across stakeholder groups
146 and arranged into higher-order themes.

147 *Ethics approval*

148 This study was approved by the National University of Singapore Institutional Review Board
149 (reference number: B-16-232).

150 **Results**

151 *Main themes*

152 We conducted a total of 40 IDIs. Among government officials, we interviewed three
153 representatives of the MoH, as well as seven members of the HPB's School Health Services
154 division. We also interviewed 19 primary healthcare professionals and two hospital infectious
155 disease specialists, as well as five preschool principals and four parents (Table 1). Overall, three
156 main themes emerged from IDIs across stakeholder groups: logistics, stakeholder engagement,
157 and funding (Figure 1). Within each of these themes, stakeholders indicated a number of
158 challenges to the successful implementation of a seasonal SIVP in Singapore, and put forward
159 suggestions to address these in the SIVP's design and implementation, in order to achieve specific
160 outcomes.

161 *Logistics*

162 Stakeholders indicated several logistical challenges to the successful implementation of school-
163 based influenza vaccination in Singapore, including the need to purchase large vaccine stocks, the
164 increased workload for school staff, and the lack of appropriate cold-chain storage facilities and
165 vaccination venues at schools. In particular, stakeholders discussed in detail the preferred setting
166 for a potential SIVP, and the mechanism for vaccine delivery.

167 *SIVP setting*

168 Although preschool-aged children are the recommended age group for influenza vaccination,
169 most stakeholders suggested to introduce the programme in primary and/or secondary schools,
170 where existing vaccination infrastructure would facilitate delivery (Figure 1A):

171 *“For the older children, it may be easier in terms of operation, because [...] you have School*
172 *Health Services going to these schools to run other vaccination programmes, and [so it] may*
173 *be feasible.” (MoH2)*

174 Singapore offers a wide range of preschool options, including public and private child care
175 centres, kindergartens, and informal play groups. This would substantially complicate the
176 recruitment of preschools for a potential SIVP:

177 *“Preschool[s] might be hard to target. Primary [and] secondary [...] might be easier to do if*
178 *they have a proper mandate to roll out [the programme in] a government school, rather*
179 *than preschools that are privately owned.” (IDS2)*

180 In addition, a SIVP implemented in primary and/or secondary schools would likely reach more
181 children, because school attendance is mandated from the age of six years:

182 *“There are children who are home-schooled up to primary school, [who] may not be*
183 *captured. [...] The pick-up rate will be higher if we start in primary school, because [the]*
184 *majority of children in our country go to a public primary school.” (PY6)*

185 A preschool principal explained that vaccine administration would also be easier among older
186 children:

187 *“I think primary school will be more appropriate. For preschool, children are still very young,*
188 *and [...] if parents are not around, it would not be very easy for teachers to manage the*
189 *child’s reaction to the jab, while managing all the other children.” (PP1)*

190 Finally, parents of older children may worry less about potential side effects of the vaccine, and
191 thus be more inclined to accept vaccination in school settings:

192 *“I think [we] should try in primary school first. [...] I think primary school parents are much*
193 *more receptive towards this, because their children are older. The tendency that their*
194 *children might fall sick because of the vaccine, or things like that, there are lesser worries*
195 *about it.” (PP4)*

196 Vaccine delivery

197 Regardless of the specific school setting, there was disagreement among participants on the
198 appropriate mechanism for vaccine delivery. Stakeholders discussed commissioning vaccination
199 to “a nurse or an equivalent stationed on site as part of the school infrastructure” (PubPD1), or
200 rotating vaccination teams:

201 *“In [the] UK [...] you actually have nurses who [...] go around visiting all the schools [...], even*
202 *carrying out vaccination [...]. So I think that’s probably a good model to look at.” (GP1)*

203 However, both these options would result in prolonged vaccination timelines. A school-based
204 nurse might be able to vaccinate “20 kids a day” (PubPD1), requiring up to one year to administer
205 the vaccine to all students in one school. Similarly, a rotating staff model would impede targeted
206 cohort vaccination at the start of the peak influenza season:

207 *“Because of how teams visit schools one after the other, it is difficult to vaccinate all children*
208 *at once. Children from different schools will be vaccinated at different times over the year.*
209 *Doing so might still give them the immunity, but [I’m] not sure it is as effective as giving*
210 *them [the vaccine] before the peak season.” (HPB5)*

211 In addition, one HPB representative argued that

212 *“even though adverse events are very rare, doctors need to be there to assess if [the] child is*
213 *fit for vaccination before giving the vaccination.” (HPB5)*

214 However, doctors’ participation would be conditional on their time availability and perceived
215 benefits:

216 *“Some general practitioners will be keen on it, others won’t. So if general practitioners have*
217 *the time, the inclination, [and] the ability to take [...] a morning off to go and [vaccinate],*
218 *[and if] they think it’s something worthwhile for them to do, then [the programme] could be*
219 *well-received. [General practitioners] would be expecting to be paid for their time.” (GP1)*

220 Stakeholder engagement

221 Most interviewees agreed that the success of a proposed SIVP would strongly depend on the
222 effective engagement of key stakeholder groups, including policy-makers, school staff, and
223 parents (Figure 1B). According to participants, developing an evidence-based, locally relevant
224 rationale that justifies the introduction of a seasonal SIVP in Singapore would increase its
225 acceptability among stakeholders (Figure 1B). However, more comprehensive evidence on the
226 local influenza burden and transmission patterns is currently needed:

227 *“The problem that one would face when [going] to a policy maker with such a proposal*
228 *would be: could you quantify the burden of influenza due to transmission in the school,*
229 *versus transmission in the community? [...] I don’t know whether we actually have such*
230 *granularity on where influenza exists. [...] So my concern with such a proposal would be, if*
231 *you go to a school, they will say: ‘can you tell me what the burden of influenza [is] in the*
232 *school?’ And nobody would be able to give a single statistic.” (PubPD1)*

233 Different stakeholders also highlighted the importance of complementing epidemiological data
234 with context-specific cost-effectiveness analyses:

235 *“[A SIVP is] something that would require some form of cost-effectiveness analysis. [...] Is*
236 *that the best use of resources? [...] If it is not cost-effective, then you are in fact putting more*
237 *burden on the healthcare system as a whole.” (MoH2)*

238 In addition, participants suggested the proposed SIVP should be complemented with extensive,
239 age-appropriate public education and awareness campaigns about influenza and the influenza
240 vaccine. Some stakeholders specifically indicated school staff as an important target of public
241 education:

242 *“I think teachers in general are knowledgeable, but they may have incorrect ideas from*
243 *social media, from the negative internet sites etc., on what [...] the true, so-called utility of*
244 *vaccination [is]. And um, many of them may still subscribe, or are subscribed to alternative*
245 *medicine. [...] I think that can be further educated, so I think that’s the important bit.”*
246 (PubPD1)

247 In addition, persuading parents and children about the importance of vaccination would be key
248 to ensuring high vaccination uptake (Figure 1B and 1C):

249 *“I think parents need to be updated, educated, and persuaded. [...] Uh, then I guess there*
250 *must be education to children, [...] so that they understand and don’t fear, and they accept.*
251 *[...] Because if we roll it out and then half the population is absent, then you’re stuck again.”*
252 (PrivPD1)

253 Improved levels of public education would also help address potential issues with vaccination-
254 related adverse events:

255 *“We need to educate people [about] what expected [adverse] events [are]. [...] I think we*
256 *need to have a good understanding of the background rates of events of interest, and then*
257 *when we embark upon this, we will say ‘Look, it is still a background rate’. Or, if [the rate] is*
258 *increased, we know it’s supposed to be increased to this amount, and no more. [...] That’s*
259 *what I mean by anticipation. [...] If we do vaccinate this number of people, we publicly tell*
260 *people, we will probably see an increase in certain events for a while.”* (PubPD1)

261 *Funding*

262 Stakeholders generally concurred that an opt out programme with free or subsidised vaccination
263 would be the most likely to achieve high vaccine coverage (Figure 1C). If parents were asked to
264 bear the cost of vaccination, a subsidy would help to increase the programme’s acceptability:

265 *“At the end of the day, I think it should be the parents who bear the cost, but of course some*
266 *perks will always entice parents, you know. [...] If you give them some form of subsidy, [...]*
267 *maybe [they will not] feel sober about the payment then.”* (PP3)

268 A free or subsidised SIVP would also make access to vaccination more equitable (Figure 1C):

269 *“If you [...] say ‘okay, we want you to pay for [the vaccine]’, [it] may be difficult for those in*
270 *the lower socioeconomic groups. And then that can create a sort of a two-tier system, and*
271 *parents are going to feel bad because they can’t afford to pay for that for their child. [...] So*

272 *if you want to offer [the vaccine] in schools, I suspect that you either need to make it very*
273 *cheap or free.” (GP1)*

274 Different interviewees suggested that the funding mechanism for the vaccine would also depend
275 on the choice of consent model (Figure 1C):

276 *“Once [the programme] is opt out, then actually the government should pay. If it is going to*
277 *be opt in, then probably the consumer.” (PriPD4)*

278 Some stakeholders recognised that vaccination of large paediatric cohorts may substantially
279 reduce the cost per dose of the vaccine. Nonetheless, a common worry among study participants
280 was that a seasonal SIVP may consume a large amount of financial resources, stripping other,
281 perhaps more important healthcare priorities of funding:

282 *“So, if such a big amount of funding [is] poured into vaccination, [...] funding [for] other*
283 *diseases, prevention, all that, might be much less. And I fear that the impact to other sides*
284 *may be ignored.” (PY3)*

285 For this reason, one representative from MoH recommended that the local need for a SIVP be
286 carefully evaluated in relation to other areas of healthcare, and its value reassessed periodically:

287 *“[An] influenza school-based programme [...] may not run effectively after like two to three*
288 *years down the road. Yeah, so that is a time where you need to evaluate again whether a*
289 *school-based programme is still useful to keep.” (MoH3)*

290 *Benefits and negative impacts of SIVP*

291 The majority of participants viewed a SIVP as the most effective way to increase influenza vaccine
292 coverage in the paediatric population in Singapore:

293 *“I think it is going to be effective, because [...] access gets much easier. Because one of the*
294 *things parents have to do is take their children out of the school and, you know, they have to*
295 *make appointments to come to the hospitals [...]. Giving [the vaccine] at school might help.*
296 *[...] It [will] improve [...] uptake.” (PD03)*

297 From the perspective of parents, major barriers to vaccinating children include the inconvenience
298 of attending yearly vaccination appointments, as well as overly complicated reimbursement
299 procedures for the cost of the vaccine. In addition, time constraints during patient consultations
300 currently prevent general practitioners from promoting and administering the influenza vaccine
301 in their practice:

302 *“Because we are so busy, sometimes we don’t even have time to manage the medical*
303 *problems per se. So preventive medicine is not [a priority]. Not just the influenza, even the*
304 *pneumococcal and cervical cancer vaccinations. [...] If we have 30 minutes with one patient*
305 *to go through all their medical problems, definitely by right we need to do the preventive*
306 *care part right. But [...] it is a time issue.” (PY06)*

307 Participants perceived the proposed SIVP as a useful tool to help overcome these specific barriers.
308 Most interviewees acknowledged that increased vaccination coverage would significantly reduce
309 the health and healthcare burden due to influenza through both direct protection of school
310 children and indirect protection among their unvaccinated contacts:

311 *“[High vaccine coverage] does provide a certain proportion of herd immunity. Because all*
312 *these kids are in the community. So [vaccination] protect[s] against [influenza] at home, in*
313 *school, in public places.” (PY2)*

314 This would ultimately reduce school and work absenteeism among children and adults,
315 respectively. However, not all participants agreed that increasing influenza vaccine uptake
316 among children would be necessary in Singapore. Some participants expressed low confidence in
317 the vaccine’s effectiveness:

318 *“We need to have a better vaccine. Despite the very high rates of vaccination in developed*
319 *countries, you still got thousands of influenza cases and hundreds of deaths [...]. If we had a*
320 *vaccine of [higher] quality, then I think people would line up to get it, and it could justify [...]*
321 *funding it publicly.” (IDS1)*

322 The misconception that influenza vaccination is only required before travelling overseas was
323 common among parents, and reflected in GPs' vaccine recommendation practices. Some
324 participants suggested a seasonal SIVP may help curb such misconceptions by increasing public
325 education and awareness of influenza and the influenza vaccine, because *"if you [vaccinate] in*
326 *schools, it forces people to think about it."* (GP1)

327 However, one concern raised by participants was the possibility that parents may then direct
328 questions about the influenza vaccine to school staff, rather than medically qualified healthcare
329 professionals. As one polyclinic doctor suggested, this would require a proposed SIVP to include
330 *"dedicated, trained personnel"* (PY6) to address parents' queries.

331 In addition, the negative publicity arising from vaccination adverse events was indicated as one
332 possible negative impact of a proposed SIVP:

333 *"By the same token of [a SIVP] being a very visible event, any negative impact would also be*
334 *a very visible event."* (PubPD1)

335 This might cause unwarranted worry among the public, likely putting *"the whole concept of*
336 *vaccination [in] negative light."* (PubPD4)

337 **Discussion**

338 This study evaluated the feasibility and acceptability of a seasonal SIVP in Singapore. Key
339 stakeholders indicated a number of logistical and financial challenges to the implementation of a
340 proposed SIVP, and suggested its feasibility would be highest in primary and/or secondary
341 schools. Successful involvement of key stakeholders would require extensive public education
342 campaigns, as well as the development of an evidence-based, locally relevant rationale that
343 justifies the introduction of a SIVP in Singapore. An opt out programme with free or subsidised
344 vaccination would achieve the highest coverage and ensure equitable access to vaccination.

345 While the existing evidence demonstrates that the introduction of seasonal SIVPs can have
346 substantial health [4–10,26–28] and economic [29,30] benefits for the wider community, this and

347 previous studies [15,31–37] suggest that the successful implementation of such programmes may
348 depend on more qualitative, context-specific aspects. A review of SIVPs in high-income countries
349 identified considerable administrative and logistical challenges to the successful delivery of
350 vaccines in schools, including the choice of organisational and funding models, the logistics of
351 vaccine supply and distribution, issues around staff capacity and workload, and communication
352 with parents and students [35]. The rationale for introducing school-based vaccination and the
353 choice of vaccine target groups were indicated as main determinants of programme effectiveness
354 [35].

355 The preference for vaccination in older children expressed by stakeholders in this study is
356 challenged by current influenza vaccine recommendations in Singapore, which only include
357 children aged five years and below [38]. The rationale underlying this recommendation is based
358 on young children’s high vulnerability to influenza infection and influenza-related complications
359 [2,39], as well as their key role as influenza transmitters in the community [39]. However,
360 simulation models show that school-aged children can also play a leading role in propagating
361 influenza outbreaks [40], and that targeted vaccination of children in this age group can have the
362 greatest impact on reducing transmission during epidemics [40]. Accordingly, influenza
363 transmission rates have been shown to fluctuate with school opening and closure periods [41,42].

364 There is substantial evidence of indirect protective benefits to unvaccinated groups from
365 vaccinating school-aged children [4–10,26–28,43–50]. However, the majority of evidence on the
366 impact and cost-effectiveness of seasonal SIVPs comes from studies in North America and Europe,
367 which have different vaccine financing mechanisms and influenza epidemiology compared to
368 Singapore. Few studies have been conducted in tropical settings, which have the added
369 complication of experiencing biannual transmission seasons. A comprehensive assessment of the
370 influenza burden and transmission patterns among young age groups would be essential to
371 understand children’s role in propagating influenza in the local context and develop a locally
372 relevant rationale for the implementation of a seasonal SIVP. In Singapore, an integrated national
373 influenza surveillance programme administered by the MoH includes community surveillance of

374 acute respiratory infections through public hospitals and polyclinics, virological surveillance of
375 influenza viruses, veterinary surveillance of poultry and bird populations, and external
376 surveillance of regional and global infectious disease incidents [51]. However, there are no
377 dedicated influenza surveillance mechanisms that capture disease and transmission patterns
378 specifically in children.

379 Most participants were forthcoming during the IDIs, and individual stakeholders demonstrated a
380 deep understanding of issues related to influenza and the influenza vaccine. However, our study
381 population displayed a general disinterest in the topic of influenza vaccination. Parents were only
382 marginally interested in discussing a potential SIVP, and did not engage in more detailed
383 conversations on issues directly relevant to them, such as consent procedures or child well-being
384 on the day of vaccination. No new themes emerged among parents after four interviews. Factors
385 potentially increasing parents' willingness to consent to a SIVP mostly emerged from IDIs with
386 preschool principals and GPs. Parents' inertia towards influenza vaccination and a proposed SIVP
387 is in contrast to previous findings from the USA, showing that parents who are relatively
388 knowledgeable with regards to influenza and the influenza vaccine can be very cognizant of the
389 public health benefits associated with SIVPs [14,52]. Misconceptions on influenza and the
390 influenza vaccine, such as the belief that the vaccine is only required before travel, were common
391 among all stakeholder groups. One participant pointed to the need to quantify and compare the
392 intensity of influenza transmission in schools versus other locations in the community, in order
393 to justify nation-wide vaccination of school children. However, the view that vaccination should
394 occur where transmission is most intense is misguided, because an immunised individual
395 exposed to influenza might be protected regardless of where vaccination occurred. The observed
396 indifference and misinformation in our study population reflect the need for more
397 comprehensive, targeted education and awareness efforts among providers and the public in
398 Singapore.

399 *Limitations*

400 Representatives of the Ministry of Education (MoE) and Early Childhood Development Agency
401 were not available to participate in this study. This prevented a more thorough investigation of
402 aspects that might be relevant to the educational sector, such as the potential disruption of
403 lessons or reduced absenteeism at schools. We were also unable to include stakeholders from the
404 primary school sector, which is overseen and centrally managed by the MoE. This study does not
405 include the perspectives of non-English speaking stakeholders. However, the vast majority of
406 young parents and all other stakeholder groups included in this study are fluent in English in
407 Singapore. Because we did not interview parents of children older than seven years, we were
408 unable to corroborate other stakeholders' statements on parental acceptance of vaccination in
409 the primary and/or secondary school setting, or parents' concerns about potential side effects
410 among older children. Finally, our sample of healthcare professionals, parents, and teachers
411 might be skewed towards pro-vaccine individuals, or those who are generally more interested in
412 vaccine-related topics. Thus, the opinions and attitudes expressed in this analysis may reflect
413 those of stakeholders who are more supportive of vaccination.

414 *Conclusions*

415 Understanding context-specific barriers and facilitators of childhood influenza vaccination can
416 help shape interventions to increase influenza vaccine coverage among young children. This
417 study evaluated the feasibility and acceptability of a seasonal SIVP in Singapore, providing
418 essential evidence to inform policy for future programmes. Overall, participants were supportive
419 of a proposed seasonal SIVP in Singapore. However, a better informed, evidence-based rationale
420 is required to gain full support across stakeholder groups and estimate the programme's impact
421 in Singapore.

422

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425 for their participation during data collection.

426

427 **Declarations of Competing Interests**

428 None

429

430 **Contribution to Authorship**

431 All authors attest they meet the ICMJE criteria for authorship. CCT conceived the idea for this
432 study and provided input for data collection, as well as analysis and interpretation of findings.
433 ML, SS and VO collected the data. VO conducted the analysis. GK provided expert advice during
434 data analysis and interpretation of research findings. CCT and VO wrote the manuscript. All
435 authors contributed to critically revising the manuscript and approved the final article.

436

437 **Details of ethics approval**

438 The study was approved by the National University of Singapore Institutional Review Board on
439 March 6th, 2017 (reference number: B-16-232).

440

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444 collection, data analysis, interpretation of research findings, or manuscript completion and
445 submission.

446

447 **Colour figures**

448 For Figure 1, colour scale is required online, but not in print.

449 **References**

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613 **Figure Legends**

614 **Figure 1. Main Themes** Three main themes emerging from in-depth interviews with
615 stakeholders, including A) Logistics, B) Stakeholder engagement, and C) funding; trapezoids:
616 challenges to implementation of a seasonal school-based influenza vaccination programme in
617 Singapore; ovals: stakeholders' suggestions to overcome these challenges; rectangles: possible
618 outcomes if specific suggestions were followed.

619 **Tables**

620 **Table 1.** Number of participants interviewed in this study by stakeholder group

Stakeholder group	Acronym	Number of interviewees
Ministry of Health	MoH	3
Health Promotion Board ^a	HPB	7
Public hospital infectious disease specialists	IDS	2
Public hospital paediatricians	PubPD	4
Private paediatricians	PriPD	4
Private general practitioners	GP	5
Polyclinic ^b doctor	PY	6
Preschool principals	PP	5
Parents of children aged 18 months to 7 years	Par	4
Total		40

621 ^a Health promotion agency of the Singapore government, responsible for delivery of routine
 622 immunisations in primary schools

623 ^b Government clinic providing subsidised outpatient care, health screenings and pharmacy
 624 services