Supplementary for: Antibiotic usage in Flusurvey

Gwen, Seb (John? Ceire?)

Contents

1 Data cleaning

Initially, 28,332 unique episodes were recorded. To clean this data, several variables where ambiguous answers were recorded were removed:

- Visit: only those episodes where the participant had responded to the medical visit question were kept for analysis (no visit, appointment made or specified visit type). This removes 380 episodes.
- Health score: only those episodes with a finite health score, between 0 and 100, were kept. This removes 13 episodes. Those episodes with infinite or missing health scores had their health score set to be "NA".
- Vaccine status: any episode where the participant had responded with a "don't know" to whether they had been vaccinated that year was removed. This removed 35 episodes.
- ILI and fever: if an NA was entered for this status then the episode was removed. This removes 30 episodes.

A total of 27,874 episodes were analysed from 3,654 participants. The total number of episodes over the 6 seasons per participant ranged from 1 to 22, with a mean of 6 episodes per participant.

2 Univariate analysis

2.1 Compare seasons

Above 3,000 episodes were recorded for each season, ranging from a total of 3,093 - 5,647 episodes per season (Figure 1). The number of antibiotic prescriptions per season ranged from 116 - 271, suggesting that analysis of prescriptions per year may be inappropriate (Figure 1). The overall prescription rate was similar for each season at around 4% (Figure 1). This equates to participants receiving antibiotics in 4% of the episodes of illness.

- don't include season - not much difference and too little data

2.2 By age and season

Antibiotic prescription rates are higher for children (age $<$18yrs) and the elderly ($>$65 yrs) (Figure 2). This is consistent with previous data. The same pattern can be seen across the seasons (Figure 2).

- need to include age

2.3 Influenza like illness

Episodes could be split into those where participants reported symptoms that, under the ECDC standards [ref], could be defined as an Influenza like illness (ILI) or not. Moreover, there was the option to report if a participant suffered fever during an episode. Considering antibiotic prescriptions by ILI (Figure 3), shows that episodes where participants experienced ILI were much

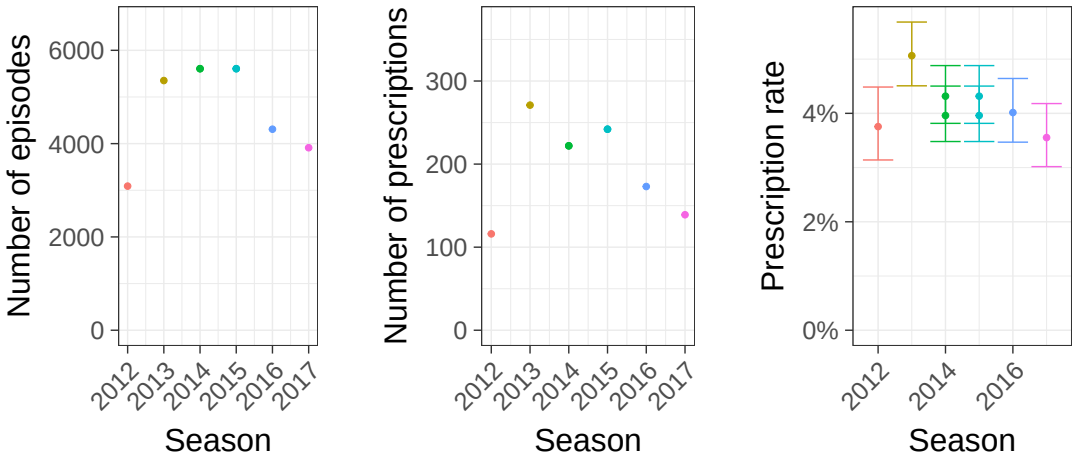


Figure 1: Comparing baseline data across seasons

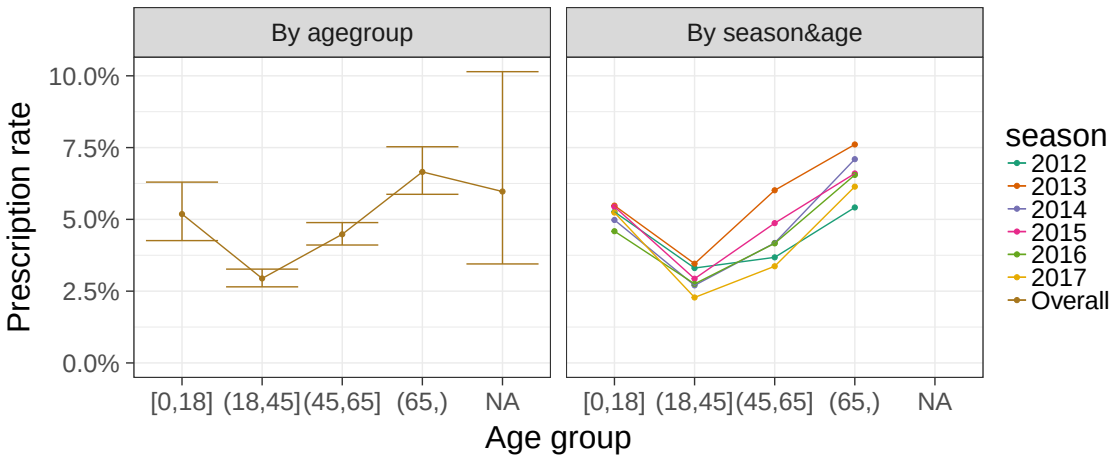
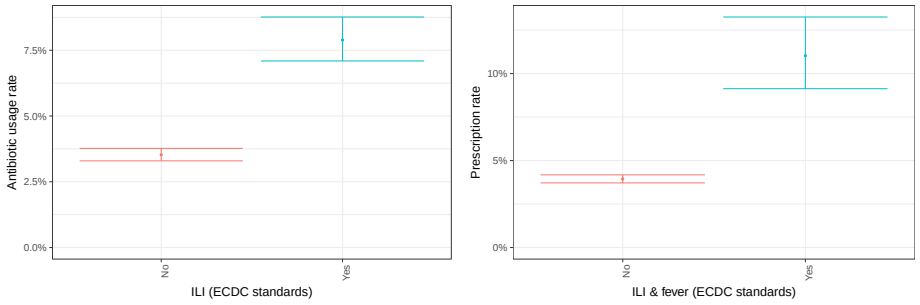


Figure 2: Comparing antibiotic prescription rate by age and season

more likely to receive antibiotics than those without ILI: 3.5% vs. 7.8% (Figure 3a). The addition of fever to the symptoms only increased the percentage of episodes that involved an antibiotic prescription: 3.9% vs. 11% (Figure 3b).



(a) **(b)**

Figure 3: Antibiotic prescriptions split by those with ECDC standards defined Influenza like illness (ILI) (a) or an ILI and fever (b)

- don't include ili
- include ili.fever (SF: tracks 'flu season well)

2.4 Region

Analysis of prescription rate by region shows little variation from the approximately 4% mean rate per episode (Figure 4). A slightly higher mean is seen for Northern Ireland. The Channel Islands and the Isle of Man were excluded for having too few reports (N = 23 or 7 respectively).

- don't include region - not much difference and too little data

2.5 Influenza vaccine status

Participants were asked to state whether they had received the influenza vaccine that year. 35 reported that they "did not know" and were excluded from the analysis. Grouping by vaccine status that year, revealed that those who had been vaccinated were more likely to receive antibiotics per episode (3.5% vs. 5.2%) (Figure 5a). This may be due to increased access to care for those who are vaccinated.

If we consider prescription rate by vaccine status and age (Figure 5b), it can be seen that those in the risk factor age for vaccination (children and elderly), do not have a difference in prescription rate by vaccine status. However, adults (18-65yo) are more likely to receive antibiotics if they have had the influenza vaccine suggesting that there is a link to care behaviour.

- include vaccine status, but needs age to be taken into account

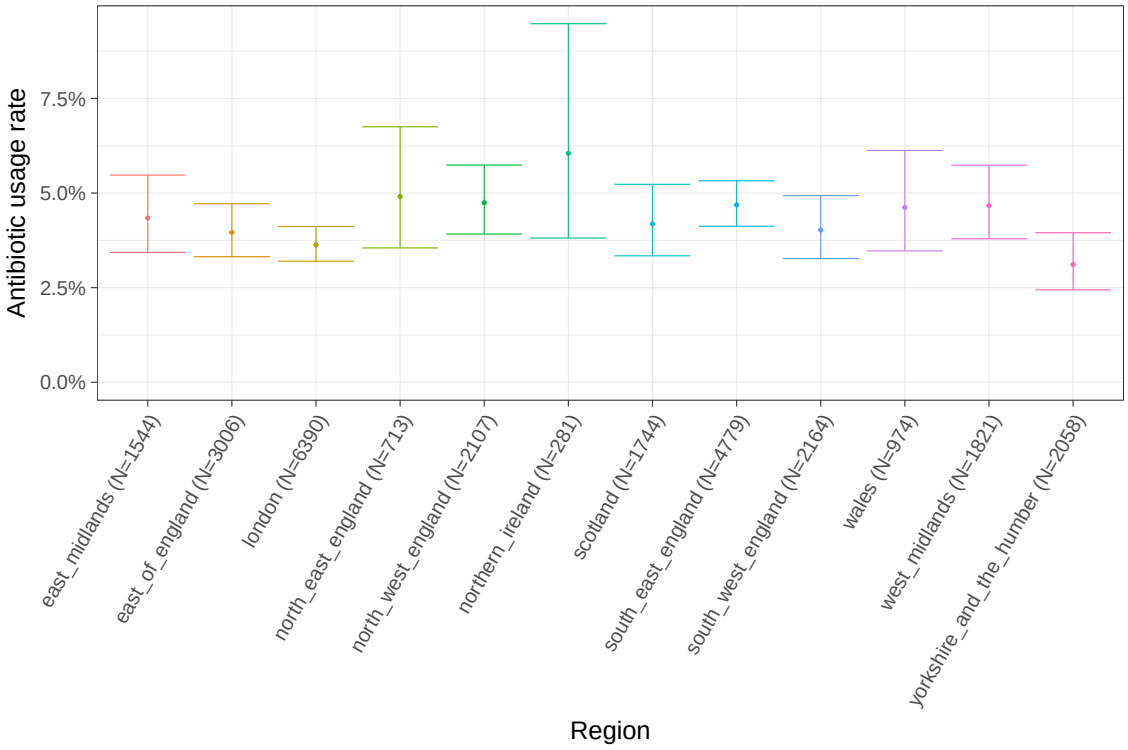


Figure 4: Comparing antibiotic prescription rate by region. Here N is the number of episodes analysed.

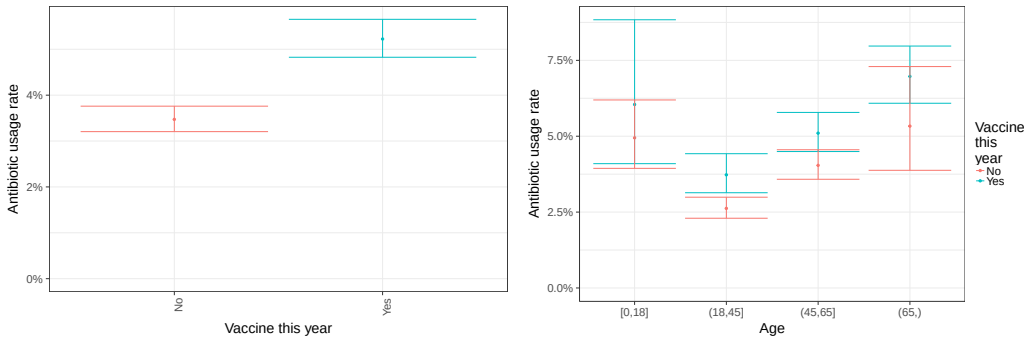


Figure 5: Antibiotic prescriptions split by those who had been vaccinated that year across all age groups (a) and then split by age group (b)

2.6 Healthcare visit during episode

Participants were asked if they had visited any medical services due to their symptoms (Figure 7a). All visits in a single episode were grouped together.

If we consider antibiotic prescription rate by any medical service visit (Figure 6), we can see that rates are much higher if a visit to a medical service was recorded (4% vs. 40%). This is as would be expected as antibiotics should only be available by prescription in the UK.

Looking at the type of medical service visits reveals little significant difference in rates. Importantly for analysis, most had few episodes linked to this type of medical visit behaviour. Considering only those that had >100 episodes ("*" indication, Figure 7b), suggests that higher prescription rates were found for those who visited a GP or the Hospital than visiting "Other" medical services.

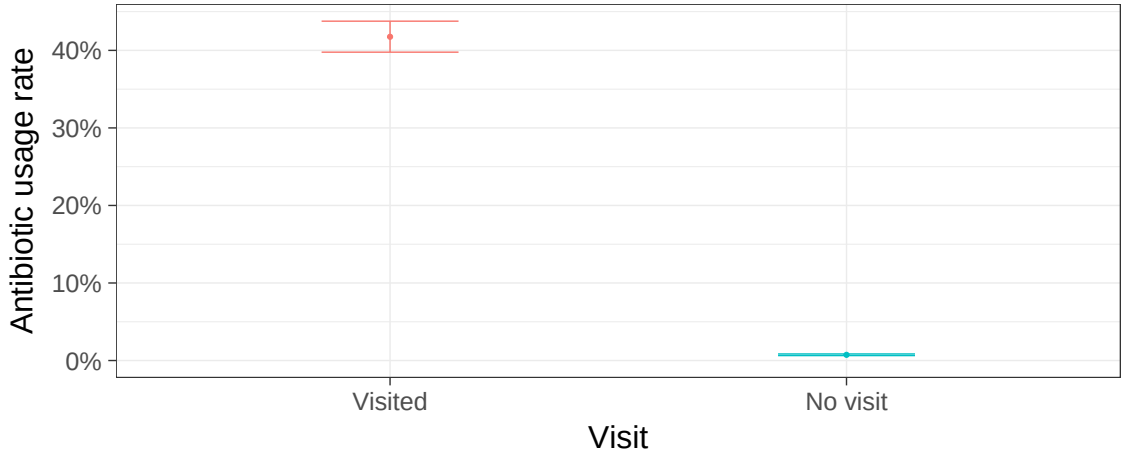
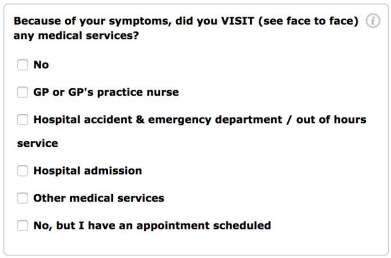
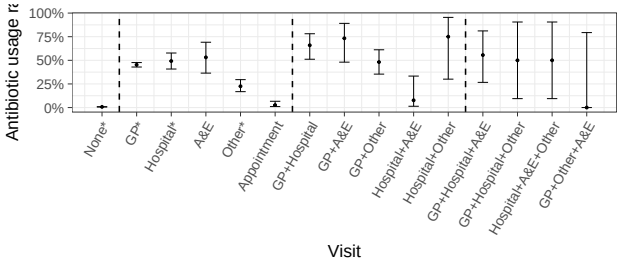


Figure 6: Did a participant visit a medical service during this episode?



(a)



(b)

Figure 7: The questions asked of participants (a) and the results for antibiotic prescription rate (b). In (b), those on the left of the first dashed line did not visit a medical service during the episode ("None"). Those in the centre section only reported visiting one medical service, to the right multiple services in an episode. A "*" indicates that more than 100 episodes had this visit behaviour recorded.

- Don't include the individual health visit behaviours

- convert to visit healthcare or not variable = visit.medical.service.no

2.7 Higher education and main activity

Analysing prescription rates by highest education status (Figure 8a) or main daily activity (Figure 8b), shows that these may have a significant impact. Those with lower levels of education ("gcse") vs. the highest ("msc"), had large differences in rates (8.6% vs. 3.4% respectively) (Figure 8a). This is consistent with previous reports of antibiotic exposure being higher in children in mothers who have lower education levels [ref]. Age may account for some of the trends by main activity as well as underlying health (Figure 8b), with those on long term leave and retired having high levels of antibiotic prescriptions.

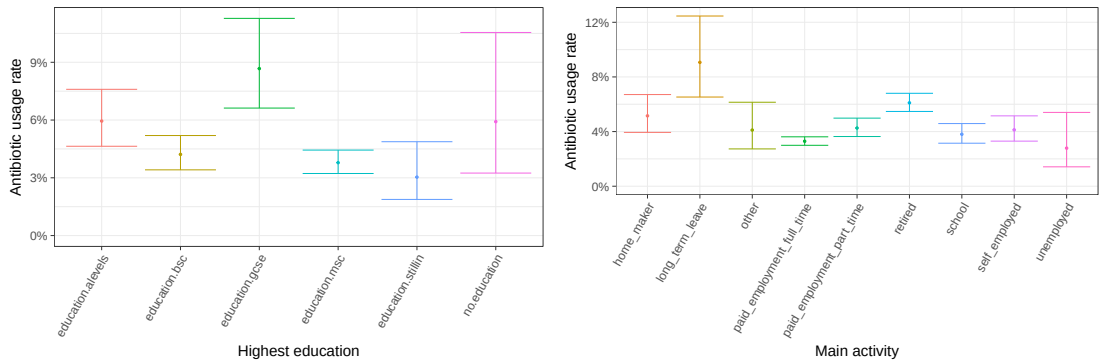


Figure 8: Prescription rates by highest education status (a) and main activity (b)

- Don't include highest education as 19,848 (71%) of episodes have no information on this
- Include main activity - affected by age and risk? All episodes have this data.

2.8 Gender

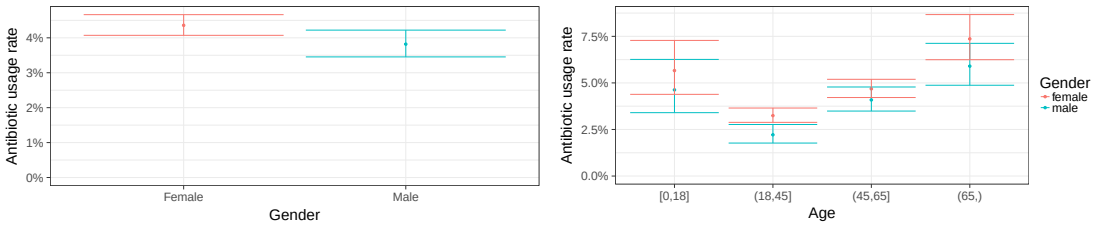
Women are more likely to be prescribed antibiotics due to the frequency of urinary tract infections (UTIs) [ref]. This trend is seen in this data (though not significantly) (Figure 9a), unless age is factored into the analysis where it is seen for young adults (18-45yo) (Figure 9b).

- Include gender (and age)

2.9 Contact with children

Those with frequent contact with children might be expected to be ill more often and hence may receive antibiotics more often. This is supported by this data (Figure 10).

- Include frequent contact with children



(a) **(b)**

Figure 9: Prescription rates by gender: alone (a) and by age (b)

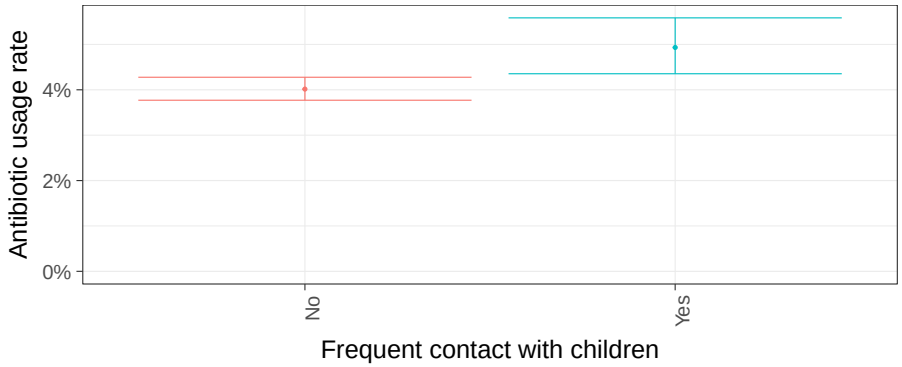


Figure 10: Comparing antibiotic prescription rate by whether you have ”frequent contact with more than 10 children”.

2.10 Health score

Health score is a self-reported, weekly value between 0 and 100. The baseline health score is the median health score (?) when a participant is not ill. This changes by season. A minimum health score is calculated as the minimum per episode. Here a normalised health score was analysed where the difference between the minimum and baseline was divided by the baseline health score. This then gives "-1" when the minimum health score during an episode was 0 (the worst it could be).

Health score is not recorded well. Out of the 27,939 episodes, 45% (12,647 episodes) have no reported minimum or baseline health score. These were removed for this analysis. Then plotting whether a participant received antibiotic against normalised health score showed little correlation (Figure 11). We might have expected lower health score to be linked to more likely to receive antibiotics.

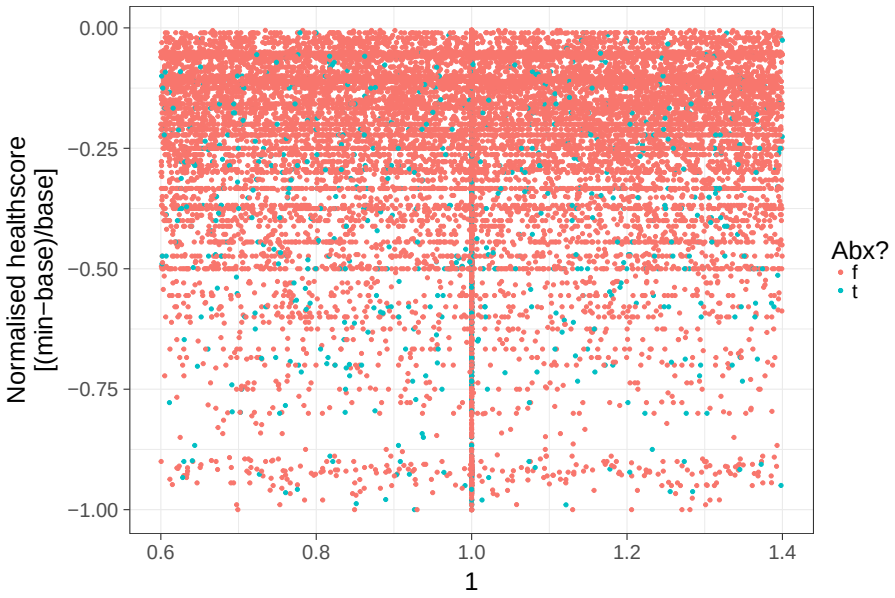


Figure 11: Antibiotic prescription by health score

- Don't include health score

2.11 Underlying health problem

Flusurvey participants are asked if they have an underlying health issue that may affect their risk of becoming ill. This included diabetes and asthma. Of those episodes where antibiotics were prescribed, 5,248 were from participants who had an underlying health issue.

It might be expected that those with an underlying health problem would also have a higher risk of receiving antibiotics. This is what we found in the Flusurvey data (Figure 12).

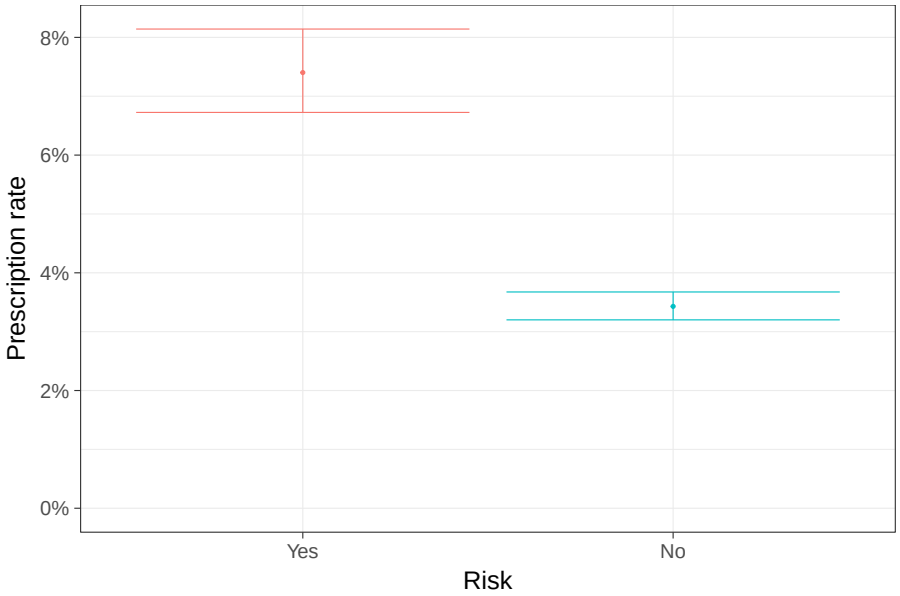


Figure 12: Antibiotic prescription by whether the participant had an underlying health problem

- Include whether a participant has an underlying health issue but not the details of the types of health score as unclear which would be more linked to antibiotic use and becomes too complex (not enough data)

3 Multivariate analysis?

Based on the above univariate analysis, the following were included in the multivariate analysis:

- Age (will be regularised) [age]
- If have ILI and fever [ili.fever]
- Vaccine status [vaccine.this.year]
- Whether they visited a medical service or not [Visit.medical.service.no]
- Main activity [main.activity]
- Gender [gender]
- Frequent contact with children [frequent.contact.children]
- Underlying health risk [norisk]

4 Thoughts

- should we include frequent contact with elderly as well as with children?