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Comparing antibiotic prescriptions in primary care between SARS-CoV-2 and influenza: a retrospective observational study

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Abstract

Background

Antibiotics are frequently prescribed during viral respiratory infection episodes in primary care. There is limited information about antibiotic prescription during the SARS-CoV-2 pandemic in primary care and its association with risk-factors for an adverse course.

Aim

To compare the proportion of antibiotic prescriptions between patients with COVID-19 and influenza or influenza-like-symptoms, and to assess the association between antibiotic prescriptions and risk-factors for an adverse course of COVID-19.

Design

An observational cohort study using pseudonymised and coded routine healthcare data extracted from 85 primary care practices in the Netherlands.

Methods

Adult patients with influenza, influenza-like-symptoms, and suspected or confirmed COVID-19 during the period 2017 up until 2020 were included. We calculated proportions of antibiotic prescriptions for influenza and COVID-19 patients and odds ratios (ORs) comparing the associations of antibiotic prescriptions in COVID-19 patients with risk factors, hospital admission, intensive care (IC) admission, and mortality.

Results

The proportion of antibiotic prescriptions during the 1st SARS-CoV-2 wave was lower than during the 2020 influenza season (9.6% vs 20.7%), difference 11.1% (95%CI:8.7-13.5). During the 2nd SARS-CoV-2 wave, antibiotic prescriptions were associated with being older than 70 (OR 2.05 95%CI:1.43-2.93), the number of comorbidities (OR 1.46 95%CI:1.43-2.93) and admission to hospital (OR 3.19 95%CI:2.02-5.03) or IC (OR 4.64 95%CI:2.02-10.62).

Conclusion

Antibiotic prescription was less common during the SARS-CoV-2 pandemic than during influenza seasons and associated with an adverse course and its risk factors. Our findings suggest a relatively targeted prescription policy of antibiotics in primary care during COVID.

Keywords:

Primary healthcare, SARS-CoV-2, antibiotics, influenza.

How this fits in

Antibiotics are frequently prescribed during viral respiratory infection episodes in primary care to treat a presumed bacterial superinfection. This may also have occurred during the SAR-CoV-2 pandemic to treat COVID. To date there is limited information on patterns of antibiotic prescription during the SARS-CoV-2 pandemic in primary care. This study shows antibiotics were less frequently prescribed in primary care during the SARS-CoV-2 pandemic compared to preceding influenza seasons. This likely points to more appropriate prescription of antibiotics when guided by dedicated diagnostic tests. Antibiotic prescription was associated with a more severe course of SARS-CoV-2, as would be expected. This suggests that GPs are able to estimate the risk of an adverse course.

Introduction

The new, severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), like all viral respiratory tract infections (RTI), carries a risk of bacterial superinfection [1-3]. Antibiotics are often prescribed by general practitioners (GPs) to reduce morbidity and mortality due to these bacterial superinfections particularly in the presence of certain risk factors [1, 4-7]. Influenza is a recognized major seasonal cause of viral RTIs and a trigger comparable to SARS-CoV-2 with regard to the risk of bacterial superinfections [4].

There is limited information on the extent of antibiotic prescriptions in Corona Viral Disease 2019 (COVID-19) patients in primary care and the associations of these prescriptions with outcomes of interest. The main disadvantage of the use of antibiotics is the development of antimicrobial resistance (AMR) [8]. Another downside is the occurrence of potential side-effects of antibiotics. Prudent antibiotic prescription is therefore still indicated and should be sustained in the current pandemic circumstances to reduce the risk of inappropriate antibiotic prescriptions to avoid unnecessary harm.

We compared antibiotic prescriptions during recent influenza seasons with those of the 1st - and 2nd SARS-CoV-2 waves in the Netherlands. In addition, associations between antibiotic prescriptions and hospital admissions, intensive care (IC) admissions, mortality, and various known risk factors, were calculated.

Methods

Study design and setting

Data collection

For this observational study, we used pseudonymised, coded routine healthcare data from patients enlisted between 2016 – 2020 with one of the 85 General Practitioner (GP) participating in the Extramural LUMC Academic Network (ELAN) medical registry, operating out of the Leiden-The Hague area. GPs involved in this network provide complete and actively updated longitudinal data on their patients via their electronic medical records (EMRs). An informed opt-out procedure for the use of these pseudonymized data is in place.

Inclusion

Influenza

Patients 18 years or older with influenza, upper RTIs, or flu-like symptoms were identified in the ELAN registry by searching the dossiers for the International Classification of primary care codes 1st edition (ICPC-1) (Table 1). Patients were included if they had any of these codes registered during influenza seasons 2017, 2018, 2019 or 2020 (Box 1) [9, 10].

Box 1. Definition and dates influenza season [9, 10]

An influenza season is defined as more than 51 patients per 100,000 inhabitants with influenza like illness or symptoms visiting their GP. For season 2019-2020, the threshold was 58 patients per 100,000 inhabitants per week.

2017: November 28, 2016 up to including March 6, 2017.

2018: December 11, 2017 up to including April 9, 2018.

2019: December 10, 2018 up to including March 11, 2019.

2020: January 27, 2020 up to including, March 15, 2020

SARS-CoV-2

We accepted two definitions for diagnosis of a COVID-19 infection: 1) COVID-19 confirmed with a positive PCR-test and an appropriate ICPC code in the EMR (Table 1), and 2) COVID-19 highly suspected, based on symptoms (Box 2) and an appropriate ICPC code in the EMR (Table 1). The 2nd definition was used due to a lack of test capacity in the Netherlands from the start SARS-CoV-2 pandemic (February 2020) until June 1st 2020. Patients were included in our study if their PCR-test or symptoms (box 2) matched the definition of COVID-19, categorized as confirmed or suspected COVID-19 and divided in two groups according to their date of diagnosis [11]. The first wave lasted from February 15, 2020 to August 1, 2020. The second wave lasted from August 1, 2020 to January 1, 2021. The SARS-CoV-2 Wuhan lineage was dominant in the Netherlands during both waves [12].

Box 2. Symptoms of SARS-CoV-2 [11]

- Coughing
- Cold
- Sore throat
- Shortness of breath while resting or during light exertion
- Loss of taste or smell
- Fever
- Sudden fatigue
- Diarrhoea
- Headache
- Conjunctivitis
- Muscle- and joint pains

Antibiotic prescriptions

The Anatomical Therapeutic Chemical Classification System code J01 was used to identify and extract data on oral antibiotic prescriptions from the ELAN registry. Prescriptions were linked with influenza patients and COVID-19 patients through the pseudonymized patient numbers following a check that the date of the antibiotic prescription corresponded with the registration date of the ICPC-1 code. If the date of the antibiotic prescription and the registration date did not correspond, the antibiotic prescription was not included.

Hospital and intensive care admissions and mortality

An adverse course of a SARS-CoV-2 infection was defined in our study as a hospital admission, IC-admission, or mortality. Data on this adverse course was extracted from the EMR in the ELAN registry through examination of the free text in the EMR of each COVID-19 patient.

Risk factors on adverse course of SARS-CoV-2

Risk factors tested for association with a severe course of a SARS-CoV-2 infection were based on the definition by the Dutch National Institute for Public Health and the Environment and outcomes of recent literature reviews on risk factors for an adverse course of COVID-19 [13-15]. Included risk factors are: age, sex, obesity, smoking, heart disease, diabetes mellitus, severe chronic respiratory disease, HIV-infection, severe renal disease, severe liver disease and Down syndrome. The definitions are listed in Table 2.

Outcome

Our outcome measures were (a) number of antibiotic prescriptions and (b) proportion of patient contacts resulting in antibiotic prescriptions during influenza seasons 2017-2020 and during the 2 waves of the SARS-CoV-2 pandemic (2020), (c) the number of hospital admissions, (d) IC-admissions and (e) deaths among COVID-19 patients.

Statistical analysis

For comparison of extent of antibiotic prescription between SARS-CoV-2 and influenza, we compared the number of antibiotic prescriptions and proportion of patient contacts resulting in antibiotic prescriptions during influenza seasons and the SARS-Covid-2 pandemic via unpaired t-tests. Association testing between risk factors and outcome measures was performed using multivariate logistic regression with age, sex, obesity and smoking added to the model as covariates with the additional risk-factors, heart disease, diabetes mellitus, severe chronic respiratory disease, Human immunodeficient virus (Hiv) infection, severe renal disease, severe liver disease and Down syndrome, merged into a composite co-morbidity variable. For calculation of this composite variable, the presence of each risk factor/disease was counted as 1 and added together as a count variable. Our multivariate logistic regression model tested the associations between these risk factors and outcome measures (a and b) antibiotic prescriptions, (c) hospital admissions, (d) IC-admissions and (e) mortality.

Multiple imputation was used to address missing data for risk factors smoking and obesity. The imputation model included all covariates and outcomes (details of multiple imputation model in supplement 1). IBM SPSS statistics version 25 was used for statistical analysis.

Results

In total, 1702 patients were diagnosed by their GP with suspected or confirmed COVID-19 in the 1st wave of 2020 with 6904 patients diagnosed in the 2nd wave (Table 3). The total number of antibiotics prescriptions was similar during the 1st wave as compared to the 2nd wave, (209 versus 238 prescriptions, respectively). The proportion of antibiotic prescriptions per patient contact was higher during the 1st wave, 9.6% (95% CI:7.9-11.4), than during the 2nd wave 2.7% (95% CI:1.4-4.0). Influenza season 2020 had the lowest number of antibiotic prescriptions per contact (20.7%) of any influenza season here analyzed. This was higher than during the 1st and 2nd SARS-CoV-2 waves 9.6% (95% CI:7.9–11.4) and 2.7% (95% CI:1.4–4.0) respectively (Table 4). All influenza seasons had a higher proportion of antibiotic prescriptions per patient contact compared two both SARS-CoV-2 waves (Table 4). During the 2nd wave, a higher proportion of the patients with suspected COVID-19 were prescribed antibiotics, 5.0% (95% CI:3.8–6.2), compared with patients with confirmed COVID-19, 2.5% (95% CI:1.3-3.7). During, the 1st wave, the proportion of prescribed antibiotics per contact was for patients with suspected, or confirmed COVID-19, 10.7% (95% CI:7.8-13.6) and 6.1% (95% CI:3.9-9.0) respectively.

Similar effect estimates were found with multivariate logistic regression using original or pooled imputed data. Therefore, results from multivariate logistic regression with pooled imputed data are presented. During the 2nd wave, an antibiotic prescription was positively associated with an age of 70 years and older (OR 2.05 95% CI:1.43-2.93), the number of comorbidities (OR 1.46 95% CI:1.18-1.82) (Figure 1), a hospital admission (OR 3.19 95% CI:2.02-5.03) or IC-admission (OR 4.64 95% CI:2.02-10.62) (Figure 2).

Discussion

Summary

In this study, we compared the frequencies of antibiotic prescription during SARS-CoV-2 episodes with those of preceding influenza episodes. We found antibiotic prescriptions to be less frequently used in primary care during SARS-CoV-2 than during influenza seasons 2017 up to and including 2020. Antibiotic prescriptions during the 2nd SARS-CoV-2 wave were associated with older age, with the number of comorbidities, and also with hospital- or IC-admission later. This association was not observed during the first wave.

Comparison with existing literature

In our study population, antibiotics were prescribed for 20-30% of patients with influenza-like illness or influenza. This may, according to the guidelines, be interpreted as inappropriate prescription. Other Dutch studies likewise show excessive antibiotic prescription during viral RTI episodes by GPs [6, 16, 17]. However, these studies include different symptoms and diseases, which makes them difficult to compare directly. The prescription of antibiotics was less common during the SARS-CoV-2 pandemic in the Netherlands, as compared to the rates recorded for RTIs pre-SARS-CoV-2.

The proportion of antibiotic prescriptions per contact for SARS-CoV-2 during the 1st wave (9.6%) was comparable to antibiotic prescribing in the management of RTI symptoms in Dutch primary care reported in a study of van der Velden during the SARS-CoV-2 pandemic (7.1%) [18].

In our study, the total sum of antibiotic prescriptions during SARS-CoV-2 did not differ much between the first and second waves. This in spite of the burden of the SARS-CoV-2 pandemic being higher during the 2nd compared to the 1st wave, reflected by the higher number of hospital admissions for COVID-19 patients in the Netherlands [19]. The relatively higher frequency of antibiotic prescriptions during the 1st wave may partly be due to registration bias, as not all COVID-19 patients during the 1st wave were registered. Another reason for the less frequent prescription of antibiotics during the 2nd wave may be the increasing knowledge on disease course and risk factors

for severe deterioration of COVID-19. Further, there were fewer non-COVID RTIs during the SARS-CoV-2 pandemic [20]. The high probability of a SARS-CoV-2 infection combined with accessible PCR-testing for SARS-CoV-2 aids the GP with diagnostic accuracy and likely decreases antibiotic prescription.

Validity and limitations

A strength of our study is the comparison of antibiotic prescriptions during influenza with those during the SARS-Cov-2 pandemic. Influenza and SARS-Cov-2 cause similar symptoms in primary care patients. Influenza was already a major seasonal cause of viral RTIs and now SARS-CoV-2, at least initially, may have the same effect on GPs behavior in primary healthcare as they frequently encounter patients with respiratory complaints due to influenza or SARS-CoV-2 and the initial assessment does not differ between the two diseases. Our study revealed increasing differences in antibiotic prescriptions which may reflect increasing experience among physicians in judging disease severance, or better estimates of potential adverse disease course development.

The results of our study may be hindered by registration bias as not all COVID-19 patients were registered (correctly) prior to June 1st 2020. The gold standard for diagnosing COVID-19 patients is a positive polymerase chain reaction (PCR) test from a nasal and throat swab (10). Until June 1th 2020, there was a lack of PCR-testing capacity in the Netherlands. As a consequence, only patients with COVID-19 symptoms assessed at an emergency department were tested. Until June 1th 2020, GPs mainly based a COVID-19 diagnosis on the medical history, patient characteristic and reported and observed symptoms. Patients were advised to contact their GP if they experienced severe symptoms. This led to under-registration of COVID-19 patients in the 1st wave, leading to a higher proportion of patients with a severe course of COVID-19 being registered. From June 2020 onwards, all patients with symptoms could be tested for SARS-CoV-2 by the municipal health services and test results were quickly passed on to GPs. But patients could have to wait up to 3 days before a PCR-test

was performed and the results were passed on. Meanwhile, they may have contacted their GPs, leading to a suspected COVID-19 registration.

At the start of the SARS-CoV-2 pandemic in the Netherlands, COVID-19 patients (with suspicion of) were not uniformly registered in the EMR with the same ICPC code. A separate ICPC code, R83.03 SARS-CoV-2, was introduced in November 2020, and slowly implemented. Most patients were registered according to their "influenza like" symptoms. For this reason, patients of 18 years and older with the ICPC codes listed in table 1 were selected broadly from our study population. As only respiratory ICPC codes were selected, we potentially missed asymptomatic COVID-19 patients, or patients with only non-respiratory symptoms associated with SARS-CoV-2. Use of routinely collected healthcare data always carries a risk of missing data, as was the case in our study. We feel confident missing data in our study is missing at random. Our percentage of hospital admissions and mortality during the 2nd wave were comparable to national percentages, suggesting any selection and registration bias in the 2nd wave was low [12, 21]. As such, we address the analysis of the 2nd wave in our primary discussion.

Implications for research and practice

We found antibiotic prescriptions were given less often for SARS-CoV-2 compared to influenza seasons. This may be due to proper testing of patients for SARS-CoV-2, along with a coinciding lower prevalence of influenza and other respiratory viruses, leading to less diagnostic uncertainty about potentially missing a bacterial infection. This may have led to more confidence in the diagnostic accuracy among physicians and hence to communicating a diagnosis to a patient with more certainty.

As a result, antibiotics to prevent or treat a possible bacterial superinfection were largely restricted to those assessed to be at risk for developing or having a more adverse course of COVID-19. Since SARS-CoV-2 testing might be the most probable explanation of increased appropriateness in antibiotic prescriptions over time, rapid point of care tests for influenza and other viral RTIs may

further reduce diagnostic uncertainty and result in fewer antibiotic prescriptions during viral RTI episodes. A Dutch study in primary care has already suggested that point of care testing for patients with RTIs may decrease antibiotic prescriptions [22].

Conclusions

We confirm that a high proportion of patients with influenza in the past four seasons were treated with antibiotics by their GP. In contrast, the rate of antibiotic prescription in primary care during the first two waves of the SARS-CoV-2 pandemic in the Netherlands was lower. COVID-19 patients who were prescribed an antibiotic were more likely to have risk factors and more often experienced an adverse course of COVID-19, as is shown by an increased number of hospital -, or IC-admissions among those prescribed antibiotics. These observations suggest a relatively targeted antibiotic prescription policy during COVID-19, but also clearly suggest that inappropriate antibiotic prescription would potentially decrease further with prior diagnostic testing for other specific viral infections.

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Funding

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Ethical approval

The Ethics Committee of the Leiden University Medical Centre approved the study design (file number G20.020).

Competing interests

The authors declared that they have no competing interests.

Supplements

Supplement 1. Multiple imputation

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Tables

Table 1. Overview of included ICPC-1 codes per disease group

ICPC-1 Code	Influenza group	SARS-CoV-2 group
R74 Acute upper respiratory infection	Yes	Yes
R75 Acute / chronic sinusitis	Yes	Yes
R77 Acute laryngitis/tracheitis	Yes	Yes
R78 Acute bronchitis / bronchiolitis	Yes	Yes
R80 Influenza	Yes	Yes
R81 Pneumonia		Yes, excluding R81.01 Legionella pneumonia
R83 Other respiratory infection		Yes, excluding R83.01 Diphtheria and R83.02 Sarcoidosis

ICPC-1: International Classification of Primary Care 1st edition. SARS-CoV-2: Severe Acute Respiratory Syndrome coronavirus-2

Table 2. Definition of riskfactors on adverse course of SARS-CoV-2

Risk factor	Definition
Age ≥ 70 year	Patients 70 years and older per 1-01-2020
Sex	Male gender
Obesity, BMI > 29	Body mass index is higher than 29 per 1-01-2020
Smoking	Patents with an active or previous smoking status per 1-01-2020
Heart disease*	ICPC K74 Angina pectoris ICPC K75 and K76 Myocardial infarct ICPC K77 Heart failure ICPC K78 Atrial fibrillation
Diabetes mellitus*	ICPC T90 Diabetes mellitus
Severe chronic respiratory disease*	ICPC R91 Chronic bronchitis ICPC R89 Congenital anomaly respiratory ICPC R91 Bronchiëctasieën ICPC R95 COPD
Hiv-infection*	ICPC B90 Use of anti-viral medication for a Hiv-infection
Severe renal disease*	ICPC U99(.01) Renal impairment and eGFR is below 25 ml/min/1.73 m^2
Severe liver disease*	ICPC D97 Cirrhosis Liver failure of liver decompensation Contra-indication label liver impairment
Down syndrome*	ICPC A90.(01) Down syndrome

BMI: Body mass index. ICPC: International Classification of Primary Care codes 1st edition. Hiv: Human immunodeficient virus. COPD: Chronic Obstructive Pulmonary Disease. eGFR: estimated Glomerular Filtration Rate.
*These risk factors were merged into one co-morbidity variable. The presence of each single risk factor/disease was counted as 1 and added together as count variable.

Table 3. Patient characteristics

Diagnosis	Influenza				SARS-CoV-2	
Year/Season	2017	2018	2019	2020	1st wave	2nd wave
Population size*	254,586	276,275	288,703	288,305	288,305	288,305
Number of patients	4579	8016	4354	1422	1702	6904
Age range in years (mean)	18-100 (51)	18-102 (51)	18-101 (51)	18-99 (48)	18-100 (50)	18-100 (48)
Confirmed SARS-CoV-2 (n)	-	-	-	-	247	5682
Suspected SARS-CoV-2 (n)	-	-	-	-	1455	1222
Number of contacts with GP practices	4858	9298	4922	1542	2165	8867
Riskfactors for adverse course SARS-CoV-2 infection						
Age ≥ 70 year % (n)	18.8 (860)	18.2 (1457)	18.5 (804)	13.3 (189)	14.9 (253)	11.7 (806)
Male % (n)	35.4 (1622)	36.5 (2929)	34.6 (1507)	37.7 (536)	38.4 (653)	42.3 (2923)
Obesity, BMI > 29 % (n)†	17.6 (807)	18.2 (1456)	18.9 (823)	17.2 (245)	6.6 (113)	16.6 (1147)
Smoking: current and previous % (n)‡	25.9 (1185)	25.9 (2077)	25.2 (1099)	23.1 (329)	9.8 (166)	19.3 (1330)
Heart disease % (n) §	12.3 (565)	10.5 (844)	10.4 (452)	7.2 (102)	3.5 (59)	8.0 (550)
Diabetes mellitus % (n)	10.4 (477)	10.5 (839)	9.8 (427)	8.2 (116)	10.6 (181)	9.9 (682)
Severe chronic respiratory disease (n)¶	3.4 (154)	3.5 (277)	3.4 (150)	2.8 (40)	6.2 (105)	2.9 (198)
Hiv-infection % (n)#	0.3 (13)	0.3 (21)	0.3 (15)	0.1 (1)	0.4 (6)	0.3 (20)
Severe kidney disease (eGFR<26) % (n)**	0.4 (19)	0.4 (35)	0.2 (9)	0.2 (3)	0.6 (11)	0.3 (21)
Liver failure % (n)††	0.1 (1)	0	0.1 (1)	0	0	0
Down syndrome % (n)	0.1 (1)	0.1 (1)	0.1 (3)	0	0	0.1 (1)

SARS-CoV-2: Severe Acute Respiratory Syndrome coronavirus-2. GP: General practitioner. ICPC: ICPC: International Classification of Primary Care codes 1st edition. BMI: Body mass index.

* In total, 348,553 individual patients were registered during the study period 2016-2020 in the ELAN Datawarehouse. The population size per year is the number of patients registered during that study year.

† Missing BMI (year/season, n): 2017, 2507; 2018, 4338; 2019, 2378; 2020, 847; 1st wave, 1434; 2nd wave, 4274.

‡ Missing smoke status (year/season, n): 2017, 2403; 2018, 4201; 2019, 2312; 2020, 805; 1st wave, 1404; 2nd wave, 4182.

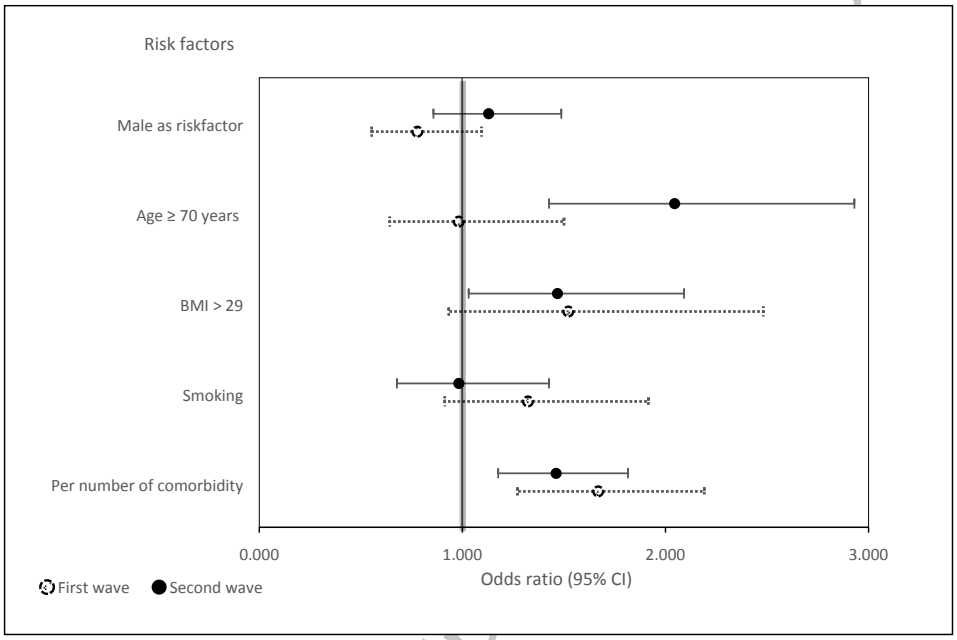
§ Heart disease: ICPC K74 Angina pectoris, ICPC K75 and K76 Myocardial infarct, ICPC K77 Heart failure, ICPC K78 Atrial fibrillation.
Diabetes mellitus: ICPC T90 Diabetes mellitus.
¶ Severe chronic respiratory disease: ICPC R91 Chronic bronchitis, ICPC R89 Congenital anomaly respirator, ICPC R91 Bronchiëctasieën, ICPC R95 COPD.
# Hiv-infection : ICPC B90, Use of anti-viral medication for a Hiv-infection.
** Severe renal disease: ICPC U99(.01) Renal impairment and eGFR is below 25 ml/min/1.73 m^2.
†† Liver failure: ICPC D97 Cirrhosis, Liver failure of liver decompensation, Contra-indication label liver impairment.

Table 4. Number of antibiotic prescriptions per season per group and observed outcome

Diagnosis	Influenza				SARS-CoV-2	
Year/season	2017	2018	2019	2020	1st wave	2nd wave
Number of patients	4579	8016	4354	1422	1702	6904
Number of contacts with GP practices	4858	9298	4922	1542	2165	8867
Antibiotic prescriptions per total contacts % (n)	25.1 (1221)	27.9 (2595)	29.6 (1458)	20.7 (319)	9.6 (209)	2.7 (238)
Penicillins % (n)	13.9 (676)	15.7 (1458)	17.7 (869)	12.6 (194)	6.7 (145)	2.2 (177)
Macrolides % (n)	3.0 (147)	3.9 (364)	3.7 (184)	2.5 (38)	1.0 (21)	0.3 (27)
Tetracyclines % (n)	8.1 (393)	8.1 (755)	8.1 (397)	5.5 (85)	1.7 (37)	0.3 (30)
Other % (n)	0.1 (5)	0.2 (18)	0.1 (8)	0.1 (2)	0.3 (6)	0.1 (4)
Observed outcome						
Hospital admissions % (n)	-	-	-	-	7.5 (128)	3.3 (227)
Intensive-care admissions % (n)	-	-	-	-	1.5 (25)	0.6 (41)
Mortality % (n)	-	-	-	-	2.1 (36)	1.0 (71)
Difference in proportion of antibiotic prescriptions between influenza seasons and SARS-CoV-2 waves						
1st wave % (95% CI)	15.5 (13.8-17.2)	18.3 (16.8-19.8)	20.0 (18.2-21.8)	11.1 (8.7-13.5)	-	-
2nd wave % (95% CI)	22.4 (21.1-23.7)	25.2 (24.2-26.2)	26.9 (25.6-28.2)	18.0 (15.9-20.1)	-	-

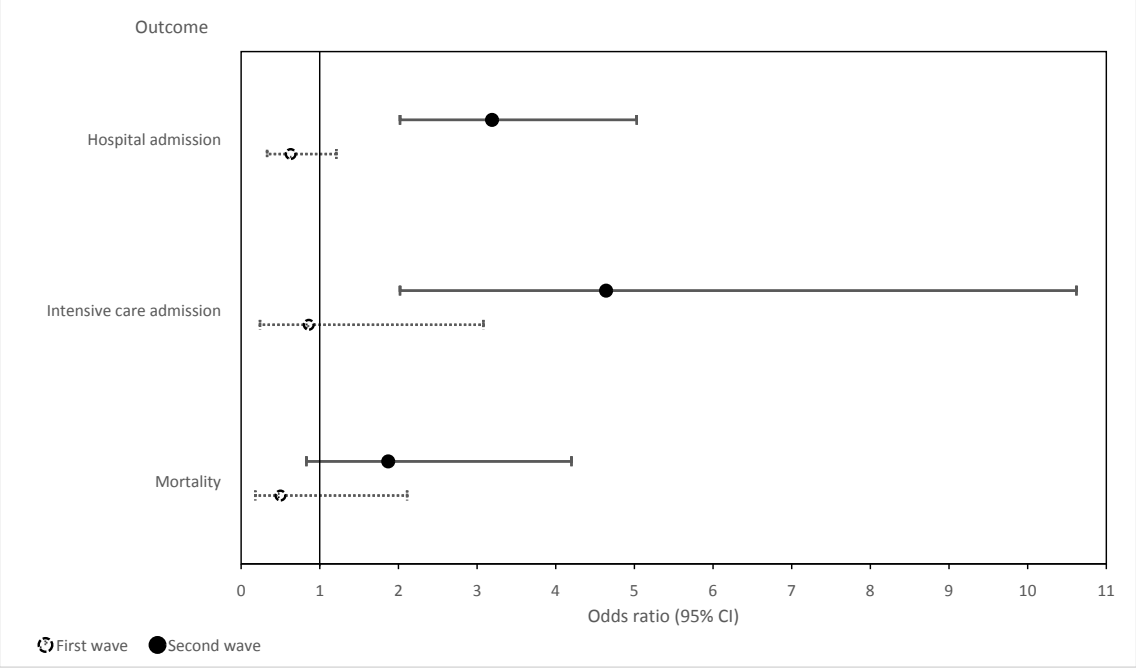
SARS-CoV-2: Severe Acute Respiratory Syndrome coronavirus-2. CI: Confidence Interval. GP: General practitioner

Figure 1. Riskfactors associated with receiving an antibiotic prescription*



BMI: Body Mass Index. CI: Confidence Interval.
* Multivariate logistic regression was performed with pooled imputed data and outcomes were adjusted for all riskfactors.

Figure 2. Observed outcome after antibiotic prescription for SARS-CoV-2*



BMI: Body Mass Index. CI: Confidence Interval.
* Multivariate logistic regression was performed with pooled imputed data and outcomes were adjusted for all riskfactors.