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## Acute bronchiolitis in Switzerland – Current management and comparison over the last two decades

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## ABSTRACT

*Background:* Although international guidelines and Cochrane reviews emphasize that therapies do not alter the natural course of acute viral bronchiolitis (AVB), they are still prescribed frequently. This survey evaluated self-reported management of AVB by Swiss pediatricians in 2019 and compared it with previous surveys.

*Methods:* We performed a cross-sectional online survey of all board-certified pediatricians in Switzerland in November 2019 and compared reported use of therapies with that reported in the 2001 and 2006 surveys. We used multivariable ordered logistic regression to assess factors associated with reported prescription of bronchodilators, corticosteroids, antibiotics and physiotherapy.

*Results:* Among 1618 contacted board-certified pediatricians, 884 returned the questionnaires (55% response rate). After exclusions were applied, 679 were included in the final analysis. Paediatricians working in primary care reported using therapeutics more frequently than those working in a hospital setting, either always or sometimes: bronchodilators 53% vs 38%, corticosteroids 37% vs 23% and antibiotics 39% vs 22%. The opposite occurred with physiotherapy: 53% reported prescribing it

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in hospital and 44% in primary care. There was an overall decrease in the prescription of therapeutics and interventions for AVB from 2001 to 2019. The proportion who reported “always” prescribing corticosteroids decreased from 71% to 2% in primary care, and of those “always” prescribing bronchodilators from 55% to 1% in hospitals.

*Conclusion:* Although we observed a significant decrease since 2001, more effort is required to reduce the use of unnecessary therapies in children with AVB.

## INTRODUCTION

Acute viral bronchiolitis (AVB) is the most common infectious disease of the small airways in infants.<sup>1</sup> AVB is caused by respiratory viruses, mainly the respiratory syncytial virus (RSV), but other viruses such as the human rhinovirus, metapneumovirus, parainfluenza virus, influenza A and B or adenovirus are also common.<sup>1,2</sup> AVB is frequently the first manifestation of an obstructive airway disease in infants and must be distinguished from obstructive bronchitis occurring later in childhood, although the transition is often fluid.<sup>3,4</sup> AVB is diagnosed clinically, based on the combination of respiratory distress and crackles, sometimes accompanied by wheezing.<sup>5</sup>

Various therapies have been studied over the last 50 years, including  $\beta$ 2-agonists, anticholinergics, inhaled and systemic corticosteroids, leukotriene receptor antagonists, antibiotics and chest physiotherapy. None of them was found to have an effect on the course of the disease.<sup>6–11</sup> In 2003, the Swiss Association of Paediatric Pulmonology published a national guideline, which advised against use of drugs and interventions like physiotherapy, and recommended only supportive treatment with supplemental oxygen, fluid management and respiratory support as needed.<sup>12</sup> We conducted national surveys among pediatricians before (2001) and after (2006) the

introduction of this guideline, which showed that AVB management changed markedly.<sup>13</sup> Since then, several international guidelines with similar recommendations have been published.<sup>5,14,15</sup>

The aims of the current study were to reassess management of AVB in Switzerland, to compare it to the 2001 and 2006 surveys, and to assess determinants of prescription of therapies for AVB.

## **METHODS**

### ***Study design and study population***

We performed a cross-sectional survey of all pediatricians working in Switzerland, including general pediatricians and pediatricians with a subspecialty. Their names, addresses and e-mail addresses were provided by the Swiss Society of Paediatrics. We sent a link to an online questionnaire via e-mail to all pediatricians, both those who were board-certified and those still in training. For this analysis, we excluded pediatricians in training to make it comparable to the 2001 and 2006 surveys. For the same reason, we also excluded those who reported not treating children with bronchiolitis, and those who did not provide information on their work location (hospital or primary care) because they had multiple missing data.. The online survey was anonymous, to increase response rate and encourage honest replies. We collected information on sex and broad age groups, but not on region. We sent the first email in November 2019, followed by three reminders after one, three and six weeks, respectively. As the questionnaire was anonymous, we sent all reminders to all eligible pediatricians.

## *Questionnaire*

We developed the questionnaire in German and French, based on the questionnaire used previously in 2001 and 2006 to assess bronchiolitis management.<sup>13</sup> We used the same questions from the previous surveys and added some extra questions to the current survey, since new therapies and treatment options had emerged in the meantime. The questionnaire included 30 questions and had four sections. First, we asked whether they treated children with bronchiolitis. Those who replied ‘yes’ were asked for number of infants with AVB treated per year (less than 10, 10-25, 25-50), and then had access to three further questionnaire sections. Section one, on diagnostic practices for AVB, included questions on the use of nasopharyngeal swabs, blood samples and chest x-rays. Section two included questions on prescription of bronchodilators (salbutamol and ipratropium bromide), corticosteroids (inhaled and systemic), antibiotics and saline inhalations. Section three assessed management, including physiotherapy, high flow nasal cannula (HFNC) for oxygen administration and discharge criteria. All participants, including those that replied ‘no’ to treating AVB, had access to the last section of the questionnaire on personal characteristics: sex, age group, mother tongue (German, French, Italian or other), workplace (hospital or primary care) and subspecialty.

There were 4 answer categories for the questions relating to diagnostic evaluations and treatment: “always”; “sometimes”; “only for high-risk children” and “never”. “High risk children” were defined as those with underlying diseases, including prematurity, bronchopulmonary dysplasia, cystic fibrosis, complicated congenital heart diseases, neuromuscular disorders, immunodeficiency or oncological chemotherapy, and severely sick children. The questionnaire was completed anonymously on the online platform Research Electronic Data Capture (REDCap)

from November 2019 to March 2020. In the 2019 survey, we did not ask if they had participated in the previous surveys.

### ***Definitions***

We classified the participants' characteristics as follows: mother tongue as German vs. any other; subspecialty as paediatric pulmonologist vs other or none; number of infants with bronchiolitis treated as 10 or more per year vs. fewer than 10. We used this cut-off for the number of infants treated per year to differentiate between those seeing many bronchiolitis patients each year and therefore having a large experience, and those seeing only a few. We enquired about mother tongue, as it is correlated to the region where the pediatrician works. The Swiss guidelines are the same for the whole country, but there are regional differences in daily practice, such as the prescription of physiotherapy, which is more frequently prescribed in the French-speaking cantons than in the German-speaking cantons. This is due to the influence of German or French medical practice.

To compare with the previous surveys, we stratified the answers into therapies for "primary care" or "hospital". Primary care therapies were defined as those described by pediatricians working exclusively in primary care. Hospital therapies were defined as those described by pediatricians working exclusively in a hospital. In general, pediatricians working in primary care in Switzerland are not the same as those working in hospitals. In hospitals, the same pediatricians usually work both in the emergency department and in the wards, because physicians rotate within the hospital.

### ***Statistical analysis***

We described reported use of the diagnostic methods and treatments separately for pediatricians working in primary care or in a hospital. We compared reported

therapies in primary care and in hospital care in 2019, 2006 and 2001. For the comparison with the 2001 and 2006 surveys, we also excluded participants who reported working in both primary care and hospitals, since the previous surveys compared only inpatient and outpatient management separately. The therapies studied were those included in the three surveys: bronchodilators (any type), corticosteroids (any administration route), antibiotics and physiotherapy. We used multivariable ordered logistic regression to assess factors associated with prescription of each therapy for hospital and primary care treatment separately. Determinants of interest were: sex, age, mother tongue, subspecialty and number of infants with bronchiolitis treated per year. We presented results as odds ratio (OR) with 95% confidence intervals, and tested the proportional odds assumption using the “omodel”- command.

<sup>16</sup> We treated missing values as a separate category when comparing proportions with previous surveys, and excluded participants with missing answers from the regression analysis. We used Stata, V.13.0 (Stata Corporation, Austin, Texas, USA) for data analysis.

We used the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting in cross-sectional studies. <sup>17</sup>

According to Swiss legislation, neither approval from the ethics committee nor informed consent from the study populations was required for this study as it was addressed to physicians and was completely anonymous.

## RESULTS

### *Study participants and response rates*

The Swiss Society of Pediatrics provided a total of 1644 email addresses of board-certified pediatricians. Of those, 1618 could be reached. Eight hundred and eighty-four (55%) participated, and 623 were finally included in the analysis (**Figure 1**). The response rate was comparable to that of previous surveys in 2001 (58%) and in 2006 (54%). The proportion of missing answers varied between the questions (**Table 2 and 3**) and was highest for bronchodilators (265/679).

Characteristics of all participants from all three surveys are presented in **Table 1**. The majority worked in primary care (2019: 68%, 2006: 67%; 2001: 71%), and most respondents treated between 10 and 50 children with AVB per year.

### *Reported therapies for bronchiolitis*

The question on bronchodilator prescription for AVB was completed by 414 pediatricians. All answer categories summarized, 38% (61/162) of pediatricians reported prescribing bronchodilators in hospitals and 53% (247/461) in primary care (**Table 2**). Most prescribed them only “sometimes” (57/61 and 222/247), and nearly all used salbutamol, though 16% (12/72) in hospitals and 11% (30/267) in primary care also added ipratropium bromide (data not shown). Corticosteroids were less frequently used (23%, 38/162 in hospital and 37%, 170/461 in primary care). Antibiotics were more frequently used in hospital (39%, 64/162) than in primary care (22%, 99/461), but never “always.” Many participants reported prescribing physiotherapy, more in hospital (53%, 87/162) than in primary care (44%, 199/461). The 56 pediatricians working both in hospitals and primary care reported prescribing antibiotics and physiotherapy similar to those working in hospitals alone and

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bronchodilators and corticosteroids similar to those working in primary care alone. Data on using nasal treatment, ribavirin and saline inhalation are presented in **Table 2**. The most frequently prescribed formula for inhaled saline was normal saline solution (23%, 36/159 in hospital and 28%, 129/456 in primary care) and 3% hypertonic saline (32%, 51/159 in hospital and 5%, 21/456 in primary care, data not shown). Other aspects of AVB management are presented in **Table 3**, including oxygen saturation cut-offs for applying oxygen and for discharge. Most participants working in a hospital setting reported using high-flow nasal cannula (HFNC) “sometimes” (77%, 125/162, data not shown).

#### ***Reported therapies for bronchiolitis compared to the years 2001 and 2006***

Overall, we observed a significant decrease in the prescription of therapies for AVB over the period from 2001 to 2019 in primary care and hospital settings (**Figure 3 and Supplementary Table 3**). In hospitals, the largest decline was seen in the proportion who reported “always” prescribing bronchodilators with a decrease from 55% to 1% ( $p < 0.001$ ). The proportion of respondents that reported never prescribing bronchodilators, increased from none, to 6% and to 7% between 2001, 2006, and 2019 among those working in primary care ( $p$  value for trend  $< 0.001$ ), and from 2%, to 7% and to 28% among those working in hospitals ( $p < 0.001$ ). In primary care, the largest decline was seen in the proportion who reported “always” prescribing steroids with a decrease from 71% in 2001 to 2% in 2019 ( $p < 0.001$ ). The proportion that reported “never” prescribing steroids, increased from 7%, to 28% and to 62% in 2001, 2006, and 2019 among those working in primary care ( $p < 0.001$ ), and from 15%, to 40% and to 46% among those working in hospitals ( $p < 0.001$ ). The proportion that reported “never” prescribing antibiotics, increased from 37%, to 61% and to 79% in 2001, 2006, and 2019 among those working in primary care ( $p < 0.001$ ). The proportion

“never” prescribing antibiotics in hospitals in 2019 was 60%. Finally, physiotherapy was “never” prescribed by 37% in 2006 and 56% in 2019 in primary care ( $p < 0.001$ ), while it decreased from 46% in 2001 to 6% in 2019 in hospitals ( $p < 0.001$ ).

### ***Determinants of reported therapies for AVB***

Older participants reported prescribing corticosteroids more frequently than younger pediatricians in primary care settings (OR 2.94, 95% CI: 1.27-6.78, among older than 60 years vs 30 to 39-year-olds). This tendency was also observed for bronchodilator prescription, but not for antibiotics and physiotherapy, and it was not as clear in hospital settings (**Figure 2** and **Supplementary Tables 1 and 2**). Primary care pediatricians with German as their mother tongue reported prescribing less physiotherapy (aOR 0.54, 95% CI: 0.36-0.80) and more corticosteroids (aOR 1.71, 95% CI: 1.11-2.64) than those from French- and Italian-speaking regions. Primary care pediatricians who treated more than 25 patients with acute bronchiolitis per year (vs. fewer) also prescribed less physiotherapy (aOR 0.60, 95% CI: 0.37-0.95). Pediatric pulmonologists in hospitals reported prescribing bronchodilators (aOR 0.21, 95% CI: 0.05-0.86) and physiotherapy (aOR 0.26, 95% CI: 0.08-0.89) less often than pediatricians with another or no sub-specialty. None of the studied factors determined the prescription of antibiotics, and the sex of the pediatricians was not a determinant of prescription of any of the studied drugs.

## **DISCUSSION**

### **Summary of findings**

This was the third national survey of AVB management among pediatricians in Switzerland in the last 20 years, the second undertaken after the introduction of national guidelines in 2003. We found that even in 2019, ineffective therapies like

bronchodilators or inhaled steroids were still often prescribed, although guidelines do not recommend them. However, we found a further reduction in the reported prescriptions for most therapies in comparison to the two previous surveys in 2001 and 2006, most obviously for bronchodilators and corticosteroids. This was the case in hospitals as well as in the primary care setting.

### **Comparison with other studies**

There is little data on pediatricians' prescribing practice for AVB and the factors that influence it. Earlier studies reported a high use of drug treatments for AVB, mainly bronchodilators (more than 90%) and corticosteroids (in 50–86%), but also antibiotics (50–53%).<sup>18,19</sup> A recent US study showed a decrease over time on the use of bronchodilators at the emergency department (ED) for AVB, from 51% in 2010 to 23% in 2019.<sup>20</sup> Another US study also reported a decline in the use of bronchodilators and steroids both in the ED and for inpatients since 2006, with a 2-fold greater decrease after the publication of the 2014 updated American Academy of Pediatrics guidelines.<sup>5,21</sup> These decreasing trends in the use of different therapies for AVB may be therefore explained by the extensive literature showing that these therapies are not effective,<sup>6–11</sup> and the implementation of clinical guidelines recommending against their use.<sup>5,12</sup>

### **Implication for practice**

This series of surveys demonstrates a significant decline in the prescription of bronchodilators and corticosteroids for AVB over the last two decades. Despite this, use of therapies remains high. In our survey, bronchodilators were still the most frequently prescribed drugs in 2019. This might often have been a treatment trial, because of difficulties of differentiating acute bronchiolitis from viral induced

obstructive bronchitis.<sup>3</sup> In Switzerland, the recommendations for AVB were published in 2003, and since then, new therapies, such as inhaled hypertonic saline and high-flow nasal cannula have been studied.<sup>5,15,22</sup> Updated guidelines should also discuss these new therapies<sup>23–29</sup>, and the optimal oxygen saturation (SpO<sub>2</sub>) cut-off for oxygen delivery at 90%.<sup>5,30,31</sup>

### **Barriers to change**

However, it has already been shown that the publication of guidelines alone is not sufficient to optimize physicians' prescription and treatment behavior.<sup>32,33</sup> We did not study reasons for non-adherence, but previous studies have noted different barriers to physicians adherence such as poor attitudes about and lack of agreement with the guidelines.<sup>34–37</sup> Instead, developing guidelines in a working group which includes representatives from all teaching hospitals might help to reach a broad consensus in all regions and to implement them.<sup>33,38,39</sup> Another possible way to change behaviour is through sustainable teaching of the younger generation of pediatricians as it might be easier than to change an established behaviour of an experienced colleague. In 2008, a Swiss survey on management of AVB investigated the impact on medical management practices after the implementation of guidelines. The study showed a significant drop before and after publishing the guidelines in several medical journals and local teaching rounds all over Switzerland.<sup>13</sup>

On occasions, parents may also expect and demand medications for their sick infants, and this may influence pediatricians to prescribe ineffective medicines.<sup>18</sup> This has been addressed in Switzerland by the creation of a parents' information leaflet in the three main languages (German, French, and Italian) which describes the evidence-based management of bronchiolitis. This leaflet informs parents and prevents them

from seeing different doctors until they receive the treatment they are expecting, what is known as "doctor shopping".<sup>36,37</sup> However, in the current survey, only few pediatricians indicated that they distributed this leaflet to parents.

### **Strengths and limitations**

The strengths of this study were the national coverage of all board-certified pediatricians in Switzerland and that all three surveys (2001, 2006 and 2019) used the same questions, which made it possible to compare them. A limiting factor of this study was that we assessed physicians' own reports about therapy prescription for AVB and did not observe what they did. However, as the questionnaire was anonymous, we can assume that the answers were honest. Despite the anonymous questionnaire, the proportion of missing answers on bronchodilator prescription was high. We speculated that some physicians use bronchodilators contrary to the recommendations. Bronchodilators might be used because the difficulties in distinguishing acute bronchiolitis from viral obstructive bronchitis. Another limitation was that we had little personal information from the participants, as the survey was anonymous. This limited the number of determinants of therapies that we could study. Finally, the proportion of pediatricians treating less than 10 infants for AVB per year decreased from 32% in 2001 to 19% in 2019. This may have affected the results, as treating a larger number of infants for AVB may increase a pediatrician's experience and might reduce the use of non-recommended treatments.

In summary, despite declining prescriptions of bronchodilators, corticosteroids, antibiotics and physiotherapy in the last two decades in Switzerland, further effort is required to reduce the use of unnecessary therapies in children with acute viral bronchiolitis.

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## **AUTHORS' CONTRIBUTION**

Conceived and designed the study: KH, CA, JH, CEK, and JB; conducted the study: KH, CA, CEK; analyzed the data: CA; wrote the paper: KH, CA, CEK, JB; approved the final draft of the manuscript: KH, CA, JH, CEK, JB

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The authors have no conflict of interest.

## **DATA AVAILABILITY STATEMENT**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## FIGURES

**Figure 1:** Study population

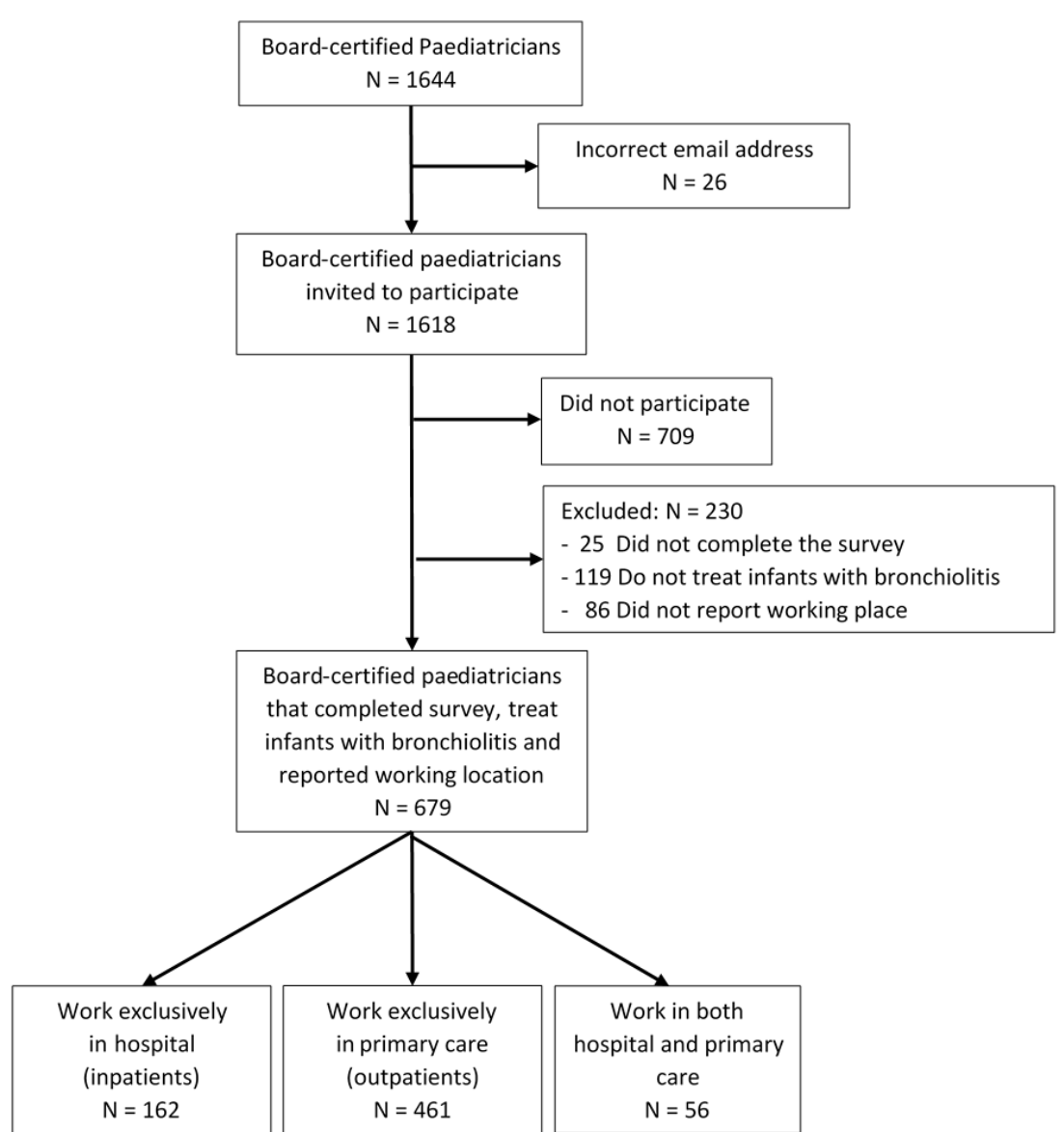
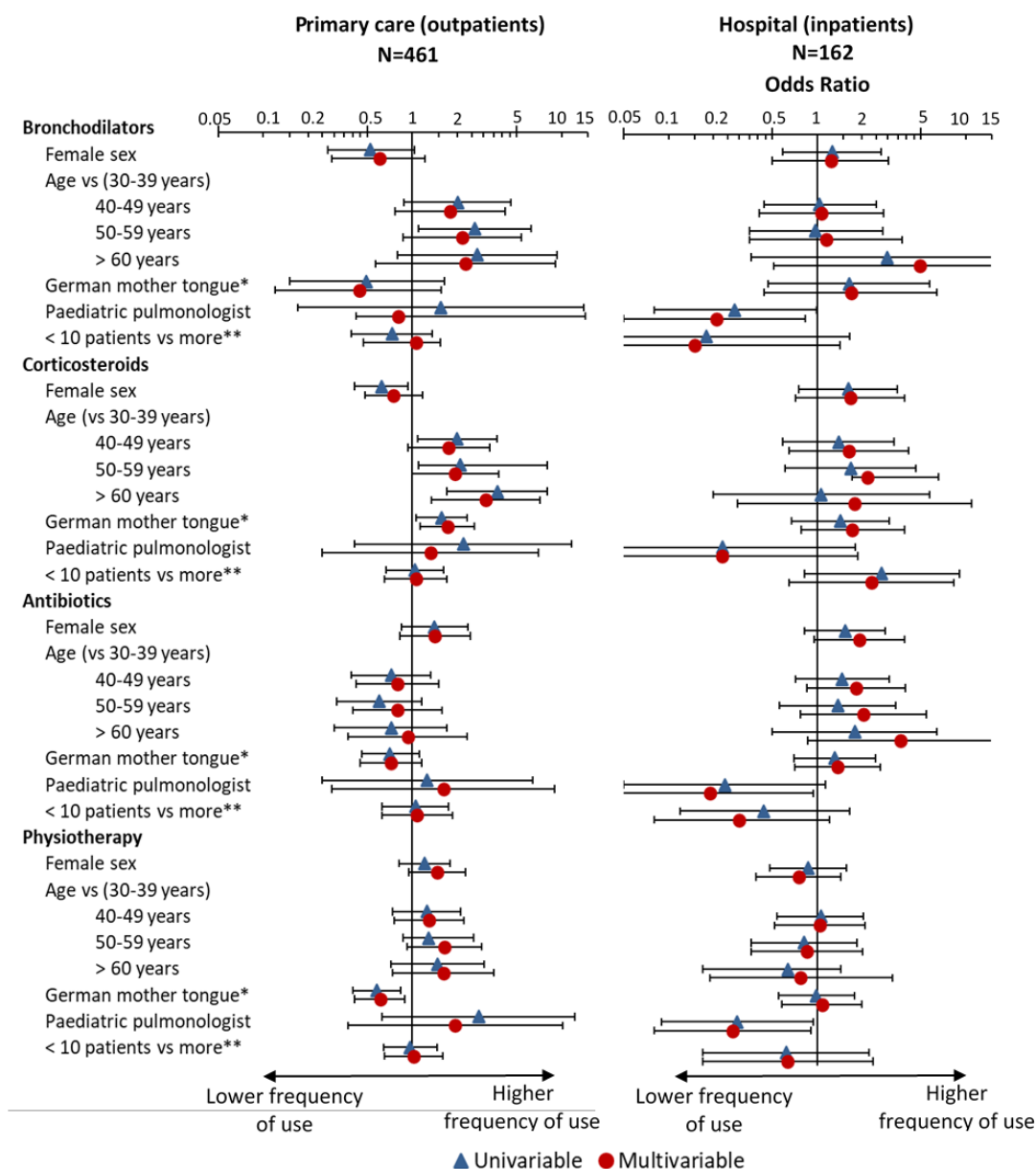
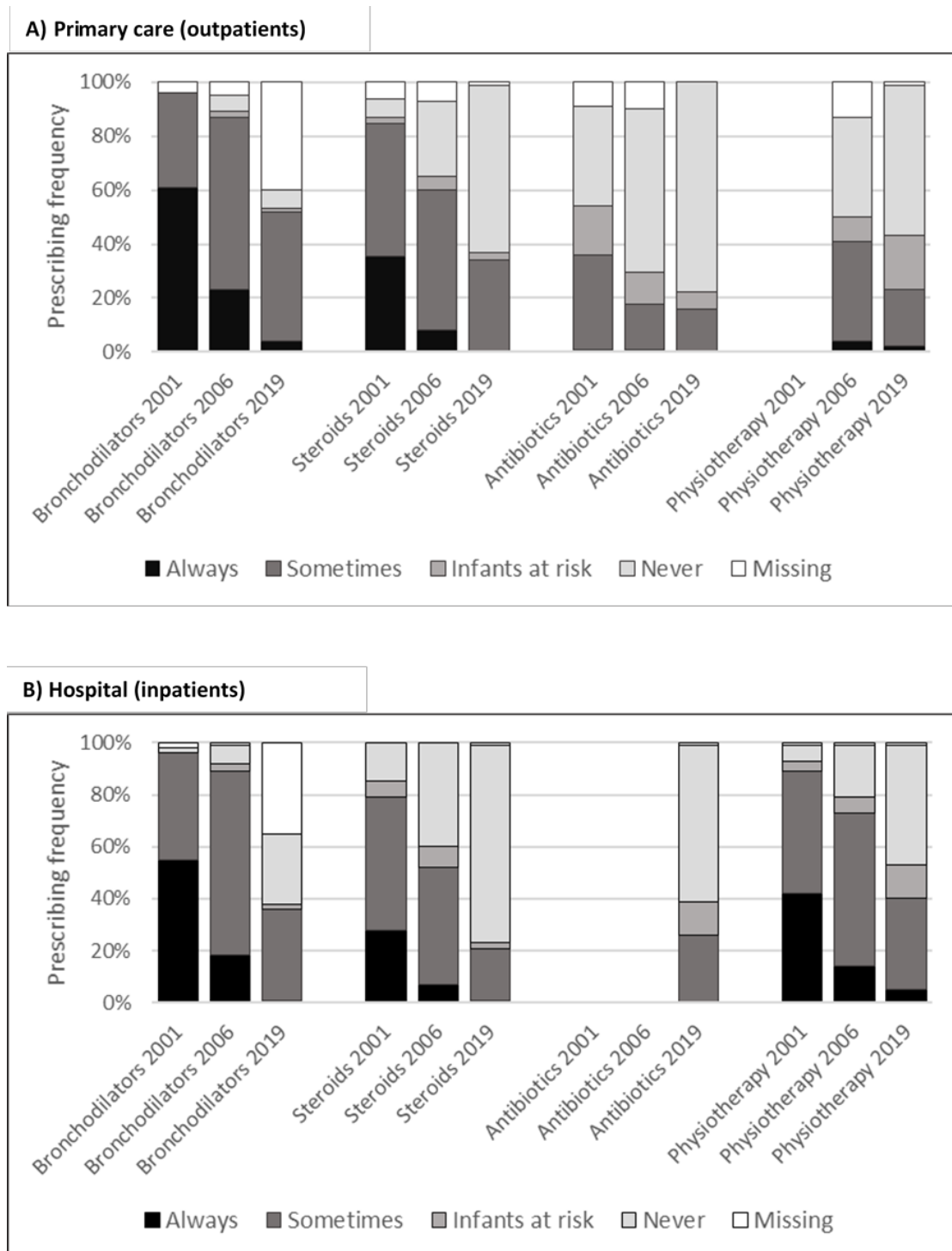


Figure 2: Determinants of reported prescription of bronchodilators, steroids, antibiotics and physiotherapy for infants with acute bronchiolitis in hospital and primary care (from ordered logistic regression model). \*German mother tongue vs French, Italian or other. \*\* Number of infants with bronchiolitis treated per year. Multivariable odd ratios adjusted for all the variables in the model (for each treatment).



\*German mother tongue vs French, Italian or other. \*\* Number of infants with bronchiolitis treated per year. Multivariable odd ratios adjusted for all the variables in the model (for each treatment).

Figure 3. Prescription of bronchodilators, steroids, antibiotics and physiotherapy for infants with acute bronchiolitis in (A) primary care and (B) hospitals in 2001, 2006 and 2019. P value for trend <0.001 for all the treatments presented.



**Table 1:** Characteristics of pediatricians treating infants with acute bronchiolitis in Switzerland in 2001, 2006 and 2019

	2001 n (%)	2006 n (%)	2019 n (%)	P value for trend
<b>Female gender</b>			449 (66)	
<b>Age</b>				
< 30 years			1 (0)	
30-39years			141 (21)	
40-49 years			275 (40)	
50-59 years			202 (30)	
>59 years			60 (9)	
<b>Mother tongue</b>				
German	279 (66)	331 (67)	396 (59)	0.006
French	143 (34)	167 (33)	220 (33)	
Italian			37 (5)	
Other			23 (3)	
<b>Work place</b>				
Hospital	102 (24)	153 (31)	218 (32)	0.120
Private practice	301 (71)	331 (67)	517 (76)	

Other	19 (5)	14 (3)	21 (3)	
<b>Sub-speciality</b>				
Pediatric pulmonologist	16 (4)	18 (4)	24 (4)	0.995
Other sub-speciality or general pediatrician	406 (96)	480 (96)	614 (96)	
<b>Number of bronchiolitis patients treated</b>				
<10 per year	133 (32)	125 (26)	144 (19)	<0.001
10 or more per year	278 (68)	361 (74)	608 (81)	

**Table 2:** Prescribed treatments of infants with bronchiolitis by board-certified pediatricians in

Switzerland, stratified by working location (2019 survey, Switzerland)

	<b>Hospital (inpatients)</b>	<b>Primary care (outpatients)</b>	<b>Both hospital and primary care</b>
	N = 162	N = 461	N = 56
	n (%)	n (%)	n (%)
<b>Bronchodilators</b>			
Always	1 (1)	20 (4)	5 (9)
Sometimes	57 (35)	222 (48)	20 (36)
Infants at risk	3 (2)	5 (1)	0

Never	45 (28)	30 (7)	6 (11)
Missing	56 (35)	184 (40)	25 (45)
<b>Corticosteroids</b>			
Always	1 (1)	2 (0)	0
Sometimes	33 (20)	155 (34)	17 (30)
Infants at risk	4 (2)	13 (3)	1 (2)
Never	124 (77)	287 (62)	38 (68)
Missing	0	4 (1)	0
<b>Inhaled saline</b>			
Always	3 (2)	23 (5)	2 (4)
Sometimes	68 (42)	117 (25)	28 (50)
Infants at risk	4 (2)	8 (2)	3 (5)
Never	87 (53)	312 (68)	23 (41)
Missing	0	1 (0)	0
<b>Antibiotics</b>			
Always	0	0	0
Sometimes	43 (26)	73 (16)	13 (23)
Infants at risk	21 (13)	26 (6)	5 (9)

Never	97 (60)	362 (78)	36 (64)
Missing	2 (1)	0	2 (4)
<b>Nasal treatment</b>			
None	2 (1)	3 (1)	0
Rinse	156 (96)	450 (98)	56 (100)
Suction	111 (68)	226 (49)	27 (48)
Decongestants	121 (74)	389 (84)	47 (84)
<b>Physiotherapy</b>			
Always	8 (5)	7 (2)	0
Sometimes	57 (35)	100 (22)	19 (34)
Infants at risk	22 (13)	92 (20)	12 (21)
Never	75 (46)	260 (56)	25 (45)
Missing	1 (1)	2 (0)	0
<b>Ribavirin</b>			
Always	0	0	0
Sometimes	1 (1)	1 (0)	2 (4)
Infants at risk	16 (10)	16 (4)	5 (9)
Never	145 (89)	443 (96)	49 (88)



Missing	1 (1)	1 (0)	0
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**Table 3:** Non-medical aspects of management of infants with bronchiolitis by board-certified pediatricians in Switzerland, stratified by working location (2019 survey, Switzerland)

	<b>Hospital (inpatients)</b> N = 162 n (%)	<b>Primary care (outpatients)</b> N = 461 n (%)	<b>Both hospital and primary care</b> N = 56 n (%)
<b>Oxygen saturation cut-off for apply oxygen</b>			
≥ 88%	10 (6)	43 (9)	3 (5)
≥ 90%	108 (66)	248 (54)	34 (61)
≥ 92%	41 (25)	161 (35)	19 (34)
Missing	4 (2)	9 (2)	0
<b>Oxygen saturation cut-off for discharge</b>			
≥ 88%	16 (10)	10 (2)	2 (4)
≥ 90%	88 (54)	138 (30)	28 (50)
≥ 92%	57 (35)	285 (62)	26 (46)
Missing	2 (1)	28 (6)	0

**Referral of infants for follow-up**

Always	78 (48)	229 (50)	29 (52)
Sometimes	56 (34)	93 (20)	21 (37)
Infants at risk	15 (9)	26 (5)	4 (7)
Never	12 (7)	50 (11)	1 (2)
Missing	2 (1)	63 (14)	1 (2)

**Place for follow-up**

Polyclinic	18 (11)	13 (3)	10 (18)
Paediatrician	146 (89)	334 (73)	52 (93)

**Handout of information brochure to parents**

Always	11 (7)	16 (3)	2 (4)
Sometimes	32 (20)	82 (18)	12 (21)
Infants at risk	4 (2)	6 (1)	41 (73)
Never	113 (69)	317 (69)	1 (2)
Missing	3 (2)	40 (9)	

**Guidelines used for administration of Palivizumab**

Swiss recommendations	135 (83)	328 (71)	50 (89)
German recommendations	0	8 (2)	1 (2)

American recommendations	0	0	0
Personalised per case	4 (2)	21 (5)	3 (5)
Do not prescribe Palivizumab	19 (12)	84 (18)	2 (4)
Other	4 (2)	9 (2)	0
Missing	1 (1)	11 (2)	0

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