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The definition of acute respiratory illnesses in children

S. D. M. COURT

Emeritus Professor of Child Health, University of Newcastle Upon Tyne

Summary

No generally accepted clinical classification of acute infective respiratory illness in children exists.

In this survey the clinicians accepted in advance an agreed classification using traditional categories based on the part of the respiratory tract most severely affected. The standardized recording of individual symptoms provided a measure of their frequency in each category and made possible a simple quantitative revision of the initial subjective classification.

We believe this classification could help family doctors and paediatricians, provide a sharper tool for epidemiological studies in home and hospital, and improve communication between those studying these disorders in different communities.

The nature of the problem

When we began the hospital survey in 1965 we were unable to find any established clinical classification of acute respiratory illness in children. We knew that it is difficult to secure agreement on the definitions of clinical categories by different clinicians and reproducibility in their use. Yet, whatever the difficulties, clinical classification is necessary: to measure the frequency and distribution of different types of illness; to study aetiology and pathogenesis; to predict the likely course and outcome; to guide treatment; for teaching; for the valid comparison of observations made in different departments; and for the use of the computer in diagnosis. The first question was how to begin. The clinicians taking part decided in advance to adopt a 'clinical descriptive' classification using traditional categories based on the part of the respiratory tract most severely affected. We recognized that a pre-arranged classification would, in some degree, determine the patterns of illness which would be recorded. On the other hand, since in practice the conventional labels were certain to be used it was better to meet and agree as closely as possible what they meant and then apply them as consistently as we could. This initial classification is given in Miller, Table 3, this symposium.

A genuine attempt was made to work within the framework of this classification; but with a number of clinicians making clinical observations and compiling records in separate communities where diagnostic cross-checking was impracticable, observer differences due to a variety of factors were bound to occur. One illustration is given in Table 1.

Some of the differences in the proportions of various categories diagnosed in different hospitals probably reflected true differences in the prevalence of particular types of illness in the associated communities. As all the hospitals admitting children in each community were not included in the survey, part could have been due also to different proportions of children with each category of lower respiratory illness admitted to the survey hospitals. The degree of variation, however, suggests that differing interpretation of the clinical categories and diagnostic preference also played a part. Some illnesses called 'bronchitis' in Glasgow would have been called 'bronchiolitis' in Birmingham. This reflects both professional failure to define clinical concepts in a generally accepted way, and the genuine

TABLE 1. Diagnosis of lower respiratory disease: distribution (%) of clinical categories in selected hospitals

Centre	Bronchitis	Bronchiolitis	Pneumonia	All lower respiratory disease
Glasgow	52·1	7·4	40·5	649 (100)
Newcastle	37·8	23·4	38·8	410 (100)
Manchester	36·3	33·6	30·0	476 (100)
Birmingham	21·2	44·7	34·1	824 (100)
All hospitals				
%	35·3	27·5	37·2	
No.	969	757	1022	2478 (100)

difficulties of interpretation when faced with an acute and changing clinical situation in a particular child. The degree of this diagnostic variability was unknown but it must be borne in mind in all the comparisons which are subsequently made.

Knowing that distortion will arise from the application of predetermined categories, and from inconsistency in their use, the cynic might well argue that our attempt to find a dependable clinical classification was impracticable. We did not take this view. Individual symptoms* were not defined but they were fully recorded and this provided an opportunity to assess the symptom content of our initial categories and if necessary to redefine them. The problem is how to group symptoms to form meaningful categories of illness. By what criteria can we decide that certain symptoms are more significant and others less significant in relation to the total illness and at what level does a particular symptom or group of symptoms reach the strength of association which Scadding (1967) would call a 'defining characteristic'. Frequent symptoms are obviously important though less frequent symptoms when present may be equally so: both may arise from the sector of the respiratory tract most seriously affected, and in that sense be regarded as a specific component of the category; both may be the indicators of severity. All these factors had to be considered if we were to achieve a clinical classification composed of categories which were dependable and which could be recognized with reasonable consistency by any doctor willing to be precise in his definition and recording of symptoms.

Had our data been suitable we might have proceeded in the way suggested by Scadding: 'In the case of a disease defined on a clinical-descriptive basis, practical application of the definition, which in its simplest form is quantitative, may require the insertion of carefully chosen, but more or less arbitrary statements about the magnitude of deviation from the mean of normal values that will be regarded as abnormal.'

Aware of diagnostic variability between centres and uncertain of its extent we have simply presented the frequency of each symptom for each clinical category. This simple qualitative analysis for each of the categories of illness is given in the complete report; here we have used tonsillitis, croup, bronchitis, bronchiolitis and pneumonia to illustrate the data available.

Any delineation of clinical syndromes is hindered by the overlapping of symptoms imposed by the unity of the respiratory tract. Yet, in spite of limitations, this simple analysis, by defining the content and frequency of symptoms, gave structure to the initial impressionistic categories. To add proportion to structure was more difficult. We had accepted the need, suggested in other studies, to give greater weight to some symptoms than others (Lipkin, 1964) by relating our initial categories to 'that part of the respiratory tract most severely affected' and we looked particularly at the frequency of certain symptoms in this light. An initial attempt to grade the severity of illness proved uncertain in interpretation and was abandoned. Yet severity must be taken into account in any meaningful classification of disease and we have done this with certain symptoms generally considered to be 'serious' (Table 11).

Symptoms and categories†

What follows illustrates the approach which has been described. Limited space has made necessary the presentation of selected parts rather than the complete symptom analysis but we hope our signposts on the road to redefinition of clinical categories can be followed.

Upper respiratory infections

Table 2 shows the percentage frequency of symptoms in 257 children with tonsillitis and Table 3 shows the general pattern of symptoms in all categories of upper respiratory illness. In its own right it directs attention to an important fact and raises an important question. The high incidence of convulsions in young children and of abdominal pain in older children illustrate how the clinical picture as seen in hospital may be distorted, and that the true pattern can only be obtained from studies of a complete community. When the relative distribution of symptoms in colds, pharyngitis, tonsillitis and primary otitis media was analysed, clear separation into four clinical categories did not emerge.

Although, except in common cold after infancy, the main symptom was present in all children in each individual category, the main symptoms were also frequently present in the other three. In everyday practice many doctors regard colds, pharyngitis and tonsillitis and otitis media as overlapping bands in a spectrum of upper respiratory infection (U.R.I.)

* The term 'symptom' includes 'signs' throughout the text and in the Tables.

† At certain places in the paper, and especially when we come to redefine the clinical categories, we found sub-division of the symptom frequency necessary for descriptive purposes. A symptom was considered *very frequent* if present in at least 50% of the children in one or more of the four age groups in each particular category; *frequent* symptoms were present in from 25 to 50%, and *infrequent* symptoms were present in from 10 to 25%.

In the tables the symptoms are recorded in the same order for each category; first symptoms arising in the respiratory tract, then temperature and respiratory rate, and finally symptoms arising outside the respiratory tract.

TABLE 2. Tonsillitis: frequency (%) of symptoms in 257 children

	6–11 months	1–4 years	5–14 years
No. of children	31	172	54
Nasal discharge	45	29	17
Red pharynx	58	66	70
Tonsils—with exudate	52	42	46
Tonsils—without exudate	45	57	56
Ears red drum	35	26	17
Cough	52	34	30
Fever ' 100°F	10	13	17
100–102°F	50	46	65
103–105°F	40	33	15
106°F+	0	6	4
Headache	6	9	48
Meningism	6	12	22
Convulsions	61	60	18
Vomiting	58	39	46
Abdominal pain	3	12	31

TABLE 3. Children admitted to hospital: distribution of symptoms in upper respiratory infections: frequency (%) in 500 children aged 1–4 years

Symptoms	Clinical category			
	Colds	Pharyngitis	Tonsillitis	Primary otitis media
Nasal discharge	16	30	29	42
Red pharynx	74	96	66	65
Red tonsils ± exudate	45	66	99	60
Red ear-drums	26	35	26	97

and Table 3 justifies this. We have, therefore, recognized this fact in our revised classification. Yet paradoxically we have retained and redefined the four components. We feel that until the full range of infecting agents and their distribution within the categories is known, the case for retaining separate categories of upper respiratory infection for research purposes still stands.

In upper respiratory tract illnesses the symptom analysis showed a strong tendency to linkage across the four categories. For croup there was a much greater degree of discrimination (Tables 4 and 5). Stridor was a strong defining characteristic, with hoarseness a close second; the combination of the two was virtually pathognomonic. The very frequent presence of chest recession in patients with stridor emphasized the underlying respiratory obstruction, and in the 12% with cyanosis that the obstruction had become dangerously severe.

The lower respiratory tract

Before presenting the symptomatic picture of bronchitis, bronchiolitis and pneumonia, we consider an important common symptom—increased

TABLE 4. Croup: frequency (%) of symptoms in 230 children

		6–11 months	1–4 years	5–14 years
No. of children		49	144	37
Nasal discharge		35	39	11
Red pharynx		47	64	70
Red tonsils—no exudate		35	48	54
Hoarseness		41	60	70
Stridor		98	97	97
Cough		78	85	84
Dyspnoea		63	64	81
Cyanosis		10	13	11
Chest recession		63	52	54
Rhonchi		22	28	40
Rales		12	11	3
Fever	< 100°F	35	35	46
	100–102°F	55	54	40
	103–105°F	10	9	14
	106°F+	0	2	0
Respiratory rate min	< 30	6	33	54
	30–39	41	42	19
	40–49	35	18	11
	50–59	10	4	8
	60+	8	2	5
Vomiting		26	14	24

TABLE 5. Children admitted to hospital: stridor in acute respiratory infections in children: frequency (%)

Clinical category	0–5 months	6–11 months	1–4 years	5–14 years
Common cold	7	3	1	0
Pharyngitis	0	3	1	0
Tonsillitis	0	6	1	0
Primary otitis media	0	0	1	9
Croup	—	98	97	97
Bronchitis	4	2	6	7
Bronchiolitis	1	2	3	—
Pneumonia	1	1	6	1

respiratory rate. Again, we could find no accepted definition of abnormal rates of respiration at different ages and so an arbitrary, tentative, scale was applied. We took the peak rate at the height of each illness and when the child was quiet. This is the figure presented in the Tables. Valid dividing lines between normal and abnormal respiratory rates would depend on an agreed range of normal and especially its upper limits at different ages. The arbitrary decisions we accepted were rates of > 40 per min in the first year, and > 30 per min between 1 and 14 years.

Others may draw the dividing lines differently. And although increased respiratory rates by our definition were recorded in upper respiratory infections at all ages, the distribution suggests that this arbitrary division is useful in arousing suspicion of lower respiratory involvement (Table 6)—particul-

TABLE 6. Respiratory rates in each clinical category
(A) Age 6–11 months

Frequency per cent in each category	Respiratory rate/min				
	<30	−39	−49	−59	60+
Common cold	30	27	30	3	3
Pharyngitis	32	42	13	0	5
Tonsillitis	29	39	19	3	3
Primary otitis media	27	30	27	3	3
Croup	6	41	35	10	8
Bronchitis	13	37	24	8	17
Bronchiolitis	6	20	20	11	41
Pneumonia	7	21	28	13	31

(B) Age 1–4 years

Frequency per cent in each category	Respiratory rate/min				
	<30	−39	−49	−59	60+
Common cold	58	35	3	2	1
Pharyngitis	49	34	10	2	0
Tonsillitis	55	26	10	2	1
Primary otitis media	58	24	9	1	0
Croup	33	42	18	4	2
Bronchitis	20	34	20	12	13
Bronchiolitis	10	16	29	6	35
Pneumonia	16	28	24	8	22

TABLE 7. Bronchitis: frequency (%) of symptoms in 463 children

	0–5 months	6–11 months	1–4 years	5–14 years
No. of children	150	82	177	44
Nasal discharge	53	51	54	25
Red pharynx	39	46	58	41
Tonsils red—no exudate	25	43	42	32
Cough	97	93	93	91
Dyspnoea	61	50	58	59
Cyanosis	17	5	7	7
Wheezing	65	73	64	70
Chest recession	37	28	36	25
Rhonchi	70	80	76	73
Rales	50	41	49	45
Radiographs—increased translucency	4	4	8	14
Radiographs—shadows	3	4	4	0
Fever <100°F	45	24	33	43
100–102°F	47	65	55	48
103–105°F	8	10	11	9
106°F+	0	1	1	0
Respiratory rate/min 30	6	13	20	41
39	30	37	34	29
49	24	24	20	20
59	21	8	12	2
60+	18	17	13	5
Vomiting	48	48	36	39

arly when, as is commonly the case, the infection has started with upper respiratory symptoms.

The tendency to symptom linkage across the categories so strongly present in upper respiratory tract infections was also seen through to a lesser degree in the lower respiratory infections (Tables 7, 8 and 9). A similar comparison of the frequency of selected important symptoms was therefore necessary before differentiation between the three components could be made (Table 10).

TABLE 8. Bronchiolitis: frequency (%) of symptoms in 299 children

	0–5 months	6–11 months	1–4 years
No. of children	222	46	31
Nasal discharge	42	50	48
Red pharynx	43	43	52
Cough	97	91	87
Dyspnoea	89	80	81
Cyanosis	23	22	16
Wheezing	77	72	55
Chest recession	71	50	48
Pulmonary distension	47	41	35
Rhonchi	72	63	71
Rales	64	70	64
Radiographs—increased translucency	37	46	32
Radiographs—shadow	12	17	3
Heart failure	7	6	10
Fever 100°F	42	28	32
100–102°F	52	61	48
103–105°F	5	11	16
106°F+	0.5	0	3
Respiratory rate/min 30	2	6	10
39	8	20	16
49	23	20	29
59	15	11	6
60+	51	41	35
Convulsions	1	2	10
Vomiting	49	43	26

With the exception of radiographic shadows interpreted as consolidation in pneumonia, there was no characteristic symptom or cluster of symptoms which clearly separated the three conditions. The picture could be interpreted as three overlapping syndromes with suggestive though not definitive, associations of symptoms and with a progressive increase in severity from bronchitis to pneumonia. More detailed analysis, however, suggested that a greater degree of differentiation was possible than appeared at first sight.

If we take bronchitis as the base line then the symptoms emphasized in bronchiolitis would be a greater proportion of children with abnormally rapid respiration, dyspnoea and chest recession, and, although of intermediate frequency, a significantly greater proportion with visible distension of the chest and increased translucency on the radiograph. In pneumonia, radiographic shadows interpreted as due to pulmonary consolidation were present in all children and constitute the defining characteristic of the disease. Yet apparently similar shadows were

TABLE 9. Pneumonia: frequency (%) of symptoms in 543 children

	0–5 months	6–11 months	1–4 years	5–14 years
No. of children	154	86	216	87
Nasal discharge	45	57	43	21
Red pharynx	39	46	52	44
Cough	97	85	92	87
Dyspnoea	73	64	69	48
Cyanosis	39	19	23	3
Wheezing	53	42	38	14
Chest pain	1	0	5	41
Chest recession	55	43	39	14
Pulmonary distension	14	13	10	8
Rhonchi	52	43	40	28
Rales	62	52	48	47
Radiological shadows	97	98	99	98
Heart failure	17	7	4	2
Fever < 100°F	37	12	15	11
100–102°F	50	49	49	48
103–105°F	7	27	27	34
106°F+	6	13	9	6
Respiratory rate/min < 30	6	7	16	23
39	17	21	28	34
49	23	28	24	25
59	11	13	8	6
60+	40	31	22	8
Headache	0	0	6	31
Meningism	5	5	6	11
Convulsions	6	8	11	0
Vomiting	57	51	37	54
Abdominal pain	1	1	6	36

recorded in 3% of infants with bronchitis and 14% with bronchiolitis. Does this mean incorrect diagnosis, or difficulties of radiological interpretation? Radiographic shadows were not defined, no standard techniques for taking the films was laid down, and the radiographs were examined by a number of radiologists, so the shadows in bronchitis and bronchiolitis may reflect difficulty of interpretation related to variations in their size.

We agreed beforehand that shadows are present in some children with bronchiolitis and that they arise from inflammatory peribronchial thickening and areas of collapse. However, we suspect that in radiology, as in the clinical field, there is a lack of agreed definitions of lung shadows in respiratory disease, and that there are real, though unmeasured, differences of interpretation between different observers.

Before trying, in the light of the symptom analysis, to redefine the clinical categories we consider the question of severity. Although grading the severity of illness proved impracticable, and serious symptoms were not identified in advance, Table 11 supports the concept of a progressive increase in severity of illness from bronchitis to pneumonia.

It is clear that some distinction between bronchitis, bronchiolitis and pneumonia is possible by symptom analysis, but it is not complete and the

TABLE 10. Children admitted to hospital: the distribution of selected symptoms in lower respiratory infections: frequency (%)

	Category					
	Bronchitis		Bronchiolitis		Pneumonia	
Symptom	0–1 years	1–4 years	0–1 years	1–4 years	0–1 years	1–4 years
Dyspnoea	55	58	84	81	68	69
Wheezing	69	64	74	55	47	38
Chest recession	33	36	60	48	49	38
Chest distension	8	14	44	35	13	10
Radiographic changes						
Translucency +	4	8	42	32	1	0
Consolidation	3	2	14	3	98	99

TABLE 11. Children admitted to hospital: the distribution of some serious symptoms in 1164 children with lower respiratory infections: frequency (%)

	Category					
	Bronchitis		Bronchiolitis		Pneumonia	
Symptom	0–1 years	1–4 years	0–1 years	1–4 years	0–1 years	1–4 years
Fever						
103–105°F	9	11	8	16	17	27
>106°F	0·5	1·0	0·5	3·0	9	9
Respiratory rate >60	17	13	46	35	35	22
Cyanosis	11	7	22	16	29	23
Heart failure	2	0	7	10	12	4
Death rate (%)	0·7	0·6	0·3	3·2	6·0	0·9

TABLE 12. Acute respiratory infections in children admitted to hospital: revised clinical categories*

Upper respiratory infection syndrome
Affected children are very frequently febrile with some or all of the following symptoms; red pharynx, red tonsils with or without exudate, red ear drums, cough and nasal discharge. Abnormal signs in the lungs are infrequent and chest radiographs consistently normal.

Individual categories

Colds: The principal symptom is excessive, mucoid or purulent, nasal discharge. This is very frequently associated with a red pharynx and with cough. From 6 months to 5 years, the illness is very frequently febrile.

Pharyngitis: The principal symptom is intense redness of the pharynx. Children of all ages are very frequently febrile.

Tonsillitis: The principal symptom is tonsillar redness, frequently with exudate, and very frequently with surrounding redness of the pharynx. Children of all ages are very frequently febrile.

Otitis media: The principal symptom is marked redness of the ear drum, infrequently associated with perforation and discharge. A red pharynx is very frequent in children at all ages and nasal discharge frequent in children under 5. Fever is very frequent in children under 5 but less so between 5 and 14.

Middle respiratory infections

Croup (acute laryngitis or laryngo-tracheitis): Illness mainly affecting children between 6 months and 4 years. Stridor is the constant symptom, very frequently associated with hoarseness. Cough, breathlessness and chest recession are also very frequent. Upper respiratory features are generally present; red pharynx very frequently and nasal discharge frequently.

Lower respiratory infections

Acute bronchitis: Illness affecting children mainly in the first 5 years of life. Cough is a constant symptom, and wheezing and breathlessness very frequent. Rhonchi are very frequently, and rales frequently, present. Upper respiratory symptoms mainly red pharynx and nasal discharge are frequent. The illness is very frequently febrile but high fever is infrequent. Except in a small minority chest radiographs are normal.

Acute bronchiolitis: Illness mainly affecting infants, especially in the first 6 months of life. Rapid respiration, dyspnoea, wheezing, chest recession, cough, rhonchi and rales are very frequent. Visible distension of the chest and increased pulmonary translucency on the chest radiograph are frequent and of high diagnostic significance. Upper respiratory features, especially nasal discharge and a red pharynx are frequent. Fever is very frequent, but high fever uncommon.

Pneumonia: Illness in which the essential feature is lobular segmental or lobar radiographic shadows, interpreted as pulmonary consolidation. Cough, rapid respiration, dyspnoea and rales are very frequent. Wheezing and chest recession are frequent in children under 5, especially in the first year. Cyanosis is frequent in children under 5. Upper respiratory signs are frequent, especially nasal discharge and a red pharynx. In children aged from 5 to 14, chest pain, abdominal pain, and headache are frequent and they may also complain of body aches and shivering. Fever is very frequent at all ages.

Influenza: No distinctive clinical illness which could be described as influenza was seen.

* This revision is based primarily on the frequency of each symptom. *Very frequent* meant that the symptom was present in at least 50% of children in one or more of the four age groups in any particular category; *frequent* symptoms were present in from 25 to 50%; *infrequent* symptoms were present in from 10 to 25%.

added discrimination which radiology can bring will depend on the development of accepted radiological definitions of abnormal pulmonary shadows in children.

Attempts at clinical classification by symptom analysis are a necessary exercise and we know of no record of it being applied in this way to acute respiratory illness in children. Other parameters may help to refine the classification further and differences have been shown in the epidemiological patterns of the various clinical categories of illness according to the age of the child and season of the year (Miller, Figs. 7–9, this symposium).

The discovery of specific virus agents enables us to define all the bands in the spectrum of disease caused by a particular virus; it does not remove the need for descriptive categories of disease based on measured clinical observation. So a revised version of the clinical categories is set out in Table 12. This is still a 'clinical-descriptive' or 'syndromal' classification. We believe it will be useful to family doctors and paediatricians, provide a rather sharper tool for epidemiological studies in home or hospital and increase rational communication between students of these disorders in different communities.

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