Acute lower respiratory tract infections accounted for 56.2% of hospitalized COVID-19 cases in Germany during the first three waves

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The official number of hospitalized COVID-19 cases based on the World Health Organization definition (a person with confirmed detection of SARS-CoV-2) is used in public health reporting and may have major implications on public health measures. But the definition may not adequately describe whether patients were admitted for COVID-19 or if the principal diagnosis was another disease and the patient acquired COVID-19 in the hospital or was tested positive for SARS-CoV-2 during the hospital stay without any respiratory tract symptoms. That is why we analysed the remuneration data of the national health insurances during the first three COVID-19 waves in Germany (January 2020-May 2021) provided by the Institute for the Hospital Remuneration System.

Table 1 Overview of principal diagnoses of hospitalized COVID-19 cases in Germany between January 2020 and May 2021 (first three waves); source: InEK Datenportal

| Principal diagnosis (ICD10 codes) | Hospitalized cases | Hospitalized cases with ICU stay |
|-----------------------------------|--------------------|-------------------------------|
|                                   | Cases             | Proportion        | Cases               | Proportion|
| Acute lower respiratory tract infections (J09-J22) | 206 179 | 56.2% | 55 550 | 63.7% |
| Influenza and pneumonia (J09-J18) | 193 818 | 52.8% | 54 935 | 63.0% |
| Subgroup with confirmed bacterial respiratory tract infections (e.g. Pseudomonas spp., Haemophilus influenzae, Escherichia coli) | 922 | 0.3% | 246 | 0.3% |
| Subgroup with confirmed non-coronavirus viral respiratory tract infections (e.g. influenza virus, RSV, adenovirus) | 787 | 0.2% | 86 | 0.1% |
| Other acute lower respiratory tract infections (J20-J22) | 12 361 | 3.4% | 615 | 0.7% |
| Subgroup with confirmed non-coronavirus bacterial or viral respiratory tract infections (e.g. H. influenzae, RSV) | 6 | 0.0% | 0 | 0.0% |
| Acute upper respiratory tract infections (J00-J06) | 6 119 | 1.7% | 201 | 0.2% |
| Other principal diagnoses | 154 666 | 42.1% | 31 390 | 36.0% |
| Certain infectious and parasitic diseases (A00-B99) | 23 507 | 6.4% | 2 535 | 2.9% |
| Subgroup with unspecified viral infections (B34.9) | 396 | 0.2% | 27 | 0.0% |
| Neoplasms (C00-D48) | 8 085 | 2.2% | 1 579 | 1.8% |
| Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D90) | 979 | 0.3% | 62 | 0.1% |
| Endocrine, nutritional and metabolic diseases (E00-E90) | 6 094 | 1.7% | 915 | 1.0% |
| Mental and behavioural disorders (F00-F99) | 1 170 | 0.3% | 159 | 0.2% |
| Diseases of the nervous system (G00-G99) | 4 105 | 1.1% | 1 157 | 1.3% |
| Diseases of the eye and adnexa (H00-H59) | 316 | 0.1% | 0 | 0.0% |
| Diseases of the ear and mastoid process (H60-H95) | 319 | 0.1% | 23 | 0.0% |
| Diseases of the circulatory system (I00-I99) | 24 289 | 6.6% | 8 563 | 9.8% |
| Diseases of the respiratory system (J00-J99 except J00-J22) | 13 591 | 3.7% | 5 322 | 6.1% |
| Diseases of the digestive system (K00-K93) | 11 017 | 3.0% | 1 931 | 2.2% |
| All other diseases (codes L to Z) | 54 904 | 15.0% | 5 859 | 6.7% |
| Diseases with less than four cases | 6 292 | 1.7% | 3 285 | 3.8% |
| All laboratory-confirmed COVID-19 cases | 366 964 | 100.0% | 87 141 | 100.0% |

ICU, intensive care unit; RSV, respiratory syncytial virus.
Any patient admitted and treated in a hospital, irrespective of the duration of stay, was regarded as a hospitalized COVID-19 case when the following criterion was fulfilled: a laboratory-confirmed detection of SARS-CoV-2 using polymerase chain reaction (PCR) or antigen test, irrespective of the type and presence of symptoms. COVID-19 was assumed whenever ICD-10 (International Classification of Diseases, 10th Revision) codes for an acute lower respiratory tract infection were found (J09-J22) in combination with detection of SARS-CoV-2 (U07.1). A total of 206,179 cases were counted, representing 56.2% of all 366,964 hospitalized COVID-19 cases in the first three waves in Germany (Table 1). The proportion was higher in the subgroup of 55,550 cases with an intensive care unit (ICU) stay, at 63.7%. A total of 1715 cases with an acute lower respiratory tract infection (0.8%) and a confirmed SARS-CoV-2 co-infection had an infection with bacterial species such as *H. influenzae* or other viruses such as respiratory syncytial virus (RSV) as the principal diagnosis. An upper respiratory tract infection was described in 6119 COVID-19 cases (1.7%), with only 201 of them being transiently on an ICU; 154,666 persons were treated in hospitals with other principal diagnoses, despite being COVID-19 cases (42.1%).

The high number of other principal diagnoses may partly be explained by an extrapulmonary and atypical clinical presentation, a secondary diagnosis of symptomatic hospital-acquired COVID-19 or by a positive PCR test in the absence of any COVID-19 symptoms. Misclassifications such as errors in reporting may also be an explanation. These data indicate that only a proportion of ‘COVID-19 cases’ in hospitals were primarily treated for COVID-19 presenting as an acute lower respiratory tract infection. The primary diagnosis is typically evaluated at the end of hospitalization and should describe the disease which was primarily responsible for causing the hospitalization.

Some uncertainty may remain in cases with two or more relevant diagnoses during admission, so that the final assignment is usually based on the disease that required most resources for diagnosis and treatment. Overall, the official reporting of hospitalized COVID-19 cases seems to overestimate the real number of acute COVID-19 in hospitals during the first three waves. This finding may have implications for public health measures.

**Ethics approval**

Ethics approval was not needed because the evaluation involved only anonymous remuneration data from a public source.

**Data availability**

The data underlying this article are available in InEK DatenBrowser at [https://datenbrowser.inek.org/](https://datenbrowser.inek.org/). Use of the data is restricted to non-commercial purposes.

**Author contributions**

Both authors had the conceptual idea. K.M. analysed and interpreted the data, G.K. wrote the manuscript and searched the literature, both authors revised and edited the manuscript. Both authors contributed equally.

**Conflict of interest**

The authors have no conflict of interest with relevance to the content of the article. The views expressed here are those of the authors and do not necessarily reflect those of the university.

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