Home mechanical ventilation is an established treatment option for chronic hypercapnic respiratory failure (1). Positive pressure ventilation is carried out intermittently or up to 24 h a day, either invasively via tracheostomy or non-invasively using face masks at home. Both the initiation of this type of mechanical ventilation and the regular monitoring of the effectiveness of ventilation are linked to inpatient treatment in accordance with the current guidelines (1). Based on the advantages in intensive care medicine and technical developments, an increase in this patient population has been observed (2, 3).

In response to a worsening health care situation, due at least in part to the increasing shortage of professionals, the German Bundestag formulated the Intensive Care and Rehabilitation Strengthening Act (GKV-IPReG; Intensivpflege- und Rehabilitationstärkungsgesetz). This is intended to improve the quality of care for people who need intensive outpatient care as well as to avoid false incentives and to strengthen the self-determination of those affected. Nevertheless, reliable epidemiological numbers for home mechanical ventilation in Germany are insufficiently available.

Methods
The data sets from the Federal Statistical Office were analyzed using the Operation and Procedure Classification System (OPS) indicators for home mechanical ventilation in inpatient care in the period from 2008 to 2018 (N = 505 411). Under the main procedure 8–716, the analysis comprised cases of home mechanical ventilation using a mask or tracheostomy and was subsequently broken down into procedure keys 8–716.0 (initial setting of non-invasive or invasive home mechanical ventilation) and 8–716.1 (monitoring or optimizing an previously-initiated non-invasive or invasive home mechanical ventilation). A separate analysis for invasive or noninvasive ventilation was available for 2018.

Results
Figure 1 shows an overview of inpatient initiation and follow-up visits of patients receiving home mechanical ventilation. The average age of the patients was 63.1 years (Figure 2). The greatest increase in the number of cases was found for patients over 75 years of age (+206.28%; 5226 to 16 006). In 2018, 15 865 patients (94%) were placed on non-invasive ventilation, and 1077 patients, on invasive ventilation (6%; 4% following unsuccessful weaning from the respirator, and 2% following elective initiation of invasive mechanical ventilation). In addition, 42 729 patients (93%) with non-invasive ventilation, and 3350 patients (7%) with invasive ventilation, were monitored for ventilation in 2018.

Discussion
Between 2008 and 2018, the number of patients in Germany who were hospitalized for either initiation or follow-up of home mechanical ventilation doubled. The number of cases, with almost 17 000 new initiations and over 46 000 follow-up visits of home mechanical ventilation in 2018, is extremely high. In particular, older patients receiving home mechanical ventilation are more frequently being treated as inpatients. The increase in the number of cases in patients over 75 years old was particularly noteworthy, as there is a high coincidence of substantial comorbidities in this patient group (3).

In particular, patients who receive invasive home mechanical ventilation are often dependent on specialized intensive care in their home environment, in care facilities, or in shared

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**FIGURE 1**

Development of the inpatient initiation and follow-up visits of patients receiving home mechanical ventilation showing sex distribution from 2008 to 2018 in Germany (invasive and non-invasive)
accommodation offering ventilation support (2). While this situation can enable good quality of life for some patients, other patients report severe restrictions on their health-related quality of life and a life that is not worth living (4). The latter particularly affects patients with chronic obstructive pulmonary diseases, which is the largest group of patients with home mechanical ventilation and, above all, patients with unsuccessful weaning (3, 4). The current analysis shows the importance of these relationships against the backdrop of currently more than 1000 new initiations per year of invasive home mechanical ventilation in Germany.

The rapid development of home mechanical ventilation in Germany shown here and elsewhere (3) also reveals the impending limits of the healthcare system, especially if home mechanical ventilation is primarily limited to the inpatient sector. A patient-centered realignment of the care structures could offer a sensible solution, as more recent studies suggest the potential of outpatient care for these patients (1, 5). This should not only take place against the background of inpatient capacities, but also from an economic perspective. Accordingly, outpatient care structures could be reconsidered in a more targeted manner, at least for follow-up visits of home mechanical ventilation. The high number of over 40,000 inpatient follow-up visits for non-invasive ventilation in Germany each year makes it imperative to rethink this situation. Outpatient follow-up visits should of course not only be considered from an economic point of view, but also for patient-related outcomes, as an hospitalization is a burden for seriously ill patients and those with comorbidities, and it sometimes carries additional risks (e.g. nosocomial infections).

The present analysis of the billing data can, however, only serve as a component for further health policy orientation, as only analyzing billing data can capture the reality of the patient numbers to a limited extent. Further clinical studies to assess the parameters, diagnoses, and healthcare characteristics are therefore essential in order to ensure patient-centered care for home mechanical ventilation in the future as well.

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Conflict of interest statement
Dr. Schwarz has served as a paid consultant for Philips Respironics and has received reimbursement of meeting participation fees and travel expenses from Löwenstein Medical and Philips Respironics.
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References

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