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# Homecare Respiratory Support for Patients with Chronic Respiratory Failure: the Necessity of a Long-Term Homecare Ventilation Program

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**Abstract**

Severe respiratory failure, resulting from a wide range of acute and chronic diseases such as chronic obstructive pulmonary diseases, obstructive sleep apnoea, obesity hypoventilation syndrome (Pickwickian syndrome), COVID-19, bilateral pneumonitis, kyphoscoliosis, acute respiratory distress syndrome, amyotrophic lateral sclerosis, Guillain-Barré syndrome, and others, poses a significant challenge for healthcare systems worldwide. Treating severe respiratory failure often requires long-term or lifelong respiratory support, which places a heavy burden on both patients and healthcare systems. Despite the availability of free comprehensive care for patients with chronic kidney failure and heart failure, those requiring long-term respiratory support are often deprived of adequate medical and social assistance. This gap in care leads to frequent hospitalizations, disability, and premature death of patients with severe respiratory failure, further straining healthcare resources and increasing social tension. The solution of the problem is an organisation of ambulatory centre for homecare respiratory support for patients with severe chronic respiratory failure. Homecare respiratory support demonstrated worldwide cost-effectiveness by significantly enhancing patients clinical and social outcomes, restoring their work capacity, and reducing the need for hospitalizations. This article emphasizes the necessity of a comprehensive homecare respiratory support system and highlights how inadequate assistance can result in frequent hospitalizations, increased disability, and premature death, thereby imposing an additional strain on the healthcare system.

**Keywords:** homecare respiratory support, chronic respiratory failure, long-term homecare ventilation program.

## Introduction

Nowadays, homecare respiratory support for patients suffering from severe forms of chronic respiratory failure (CRF) is a major healthcare problem of Kazakhstan. CRF is a pathological condition that complicates the course of several different diseases, including chronic obstructive pulmonary disease (COPD), progressive neuromuscular diseases, obstructive sleep apnoea syndrome, bilateral pneumonitis, acute respiratory distress syndrome, obesity hypoventilation syndrome, amyotrophic lateral sclerosis, Guillain-Barré syndrome. Treatment of severe CRF often requires highly specialized medical care, containing various options for respiratory support, in particular home respiratory support for a long period [1]. This poses a massive issue for healthcare. In turn,

**General morbidity in Kazakhstan**

| Diseases | Population 19 634 983 | | | |
|---|---|---|---|---|
| | Absolute amount | | Per 100 000 population | |
| | 2021 | 2022 | 2021 | 2022 |
| Respiratory diseases | 5 251 430 | 5 146 247 | 27 637.7 | 26 210 |
| Cardioscular diseases | 3 216 233 | 3 313 861 | 16 926.7 | 16 877 |
| Tumours | 429 216 | 447 627 | 2 258.9 | 2 280 |

**Mortality (per 100 000 inhabitants)**

| | Diseases | Population 19 634 983 | |
|---|---|---|---|
| | | 2021 | 2022 |
| 1 | Cardiovascular diseases | 226.86 | 154.39 |
| 2 | Tumours | 73.7 | 68.76 |
| 3 | Respiratory diseases | 108.94 | 66.76 |

**Respiratory diseases rank 1st in morbidity and 3rd in mortality after cardiovascular and oncological diseases**

Statistical collection 2021 and 2022..BUREAU OF NATIONAL STATISTICS, STRATEGIC PLANNING AND REFORM AGENCIES OF THE REPUBLIC OF KAZAKHSTAN

**Figure 1** – The general morbidity and mortality with the focus on respiratory diseases in Kazakhstan

home respiratory support leads to a significant improvement in the clinical status of patients, partial or complete restoration of working capacity.

## Current situation with respiratory diseases in Kazakhstan

The number of patients with chronic respiratory failure in the world is steadily growing and amounts to 328,000,000 people (5% of all patients with chronic lung diseases), and 936,000,000 of the working-age population suffers from sleep apnoea syndrome. Currently, in the Republic of Kazakhstan respiratory diseases rank 1st place in morbidity and 3rd in mortality after cardiovascular and oncological diseases (Fig. 1).

Unfortunately, there is no statistical data or patient registry available in Kazakhstan. However, according to data from the Head of the Charity Fund "Omirge sen" (2023), currently, around 450 children require non-invasive ventilation within just one category of neuromuscular diseases. Out of these 450 children, approximately 100 are already receiving non-invasive ventilation. It has also been noted that there has been a significant increase in the number of patients requiring non-invasive ventilation, due to the increased availability of diagnostic equipment in the respiratory support center. Over the past three years, the frequency of diagnoses has increased tenfold. Currently, there is an increased identification of the need for ventilation among patients who were previously not considered candidates for this treatment.

However, there is no system for providing homecare to patients in need of long-term respiratory support at the outpatient stage. The lack of a system of medical and social care for patients in need of long-term respiratory support creates a certain social tension and puts a significant burden on the healthcare system due to frequent hospitalizations, disability, and premature death of patients with severe chronic congestive respiratory failure. At the same time, for patients with chronic renal failure and heart failure, free medical care is provided in full. The social determinants or structural factors that influence the problem include high financial costs for the treatment of chronic respiratory failure, low quality of life of patients with chronic respiratory failure with frequent and prolonged hospitalizations. In the case of patients with sleep apnoea, chronic fatigue syndrome results in a decrease of the labour productivity, memory loss, frequency of traffic accidents and industrial injuries. Chronic respiratory failure following any courses are characterised by early disability and high mortality of patients [2, 3].

## Worldwide experience of homecare respiratory support

Around the world, the number of centres for Homecare respiratory support is constantly growing. The number of respiratory support centres in sixteen European countries was 329 in 2001–2004. In France, the prevalence of external respiratory support centres was 33 per 100,000 people [4].

Respiratory support improves quality of life and survival. The experience of European countries demonstrated that patients using long-term respiratory support at the home with telemonitoring experienced a 36% reduction in urgent GP visits, exacerbations, and acute conditions, resulting in 33% cost savings [5]. The estimated overall prevalence of home mechanical ventilation use in South Korea was 9.3 per 100,000, with a prevalence of 6.3 per 100,000 among children (age < 15 y.o.) [5]. The most common primary diagnoses were neuromuscular diseases (42.0%) and lung and/or airway diseases (27.7%). The number of Non-invasive ventilation (NIV) users is constantly increasing worldwide. In France, the prevalence of home respiratory support use was 33 cases per 100,000 inhabitants in 2009. In Switzerland, it has increased 2.5 times since 2000 and reached 37.9 cases per 100,000 inhabitants in 2020.

Long-term Home-based use of non-invasive ventilation (NIV) costs £19,876 and results in an average quality-adjusted life year (QALY) of 2,391. Quality-adjusted life years (QALYs) is a measure that reflects the number of additional years of life gained by a patient as a result of preventive measures or treatment. It takes into account the quality of life during that period. The incremental cost of this strategy is cost-effectiveness =£11,318 per 1=QALY [6].

Long-term home-care NIV reduces the burden on medicine by lessening hospitalizations and the need for invasive

mechanical ventilation, as demonstrated by Davay Chandra et al. (2012). Their study revealed a substantial increase in NIV usage (462%) and a notable decrease (42%) in invasive ventilation use over a decade [7]. This shift towards NIV was associated with a decrease in hospitalizations, with the average length of stay dropping from 15 to 10.5 days, resulting in significant cost savings of $158,443 per hospitalization [8]. Moreover, NIV usage is linked to a 44% reduction in the need for intubation and a 50% decrease in hospital mortality among COPD patients during exacerbations. It also helps prevent complications such as nosocomial pneumonia, reduces antibiotic usage, shortens Intensive care unit (ICU) stays, and lowers mortality rates, thereby significantly cutting healthcare expenses [9].

The effectiveness of home-care NIV is further supported by an analysis of 24 international home ventilation programs from 2005 to 2020. These programs served 35,413 users across 22 countries with a combined population of 546 million. The estimated prevalence of home ventilation ranged from approximately 7.3 to 47 per 100,000 population. Additionally, insights from developing nations suggest that a minimum budget of €168 per NMD patient annually can cover equipment costs, highlighting the cost-effectiveness of home ventilation in low to middle-income countries. Conversely, in high-income countries, a budget of approximately €1680 per patient per year is sufficient to cover the expenses of home lung ventilation [10].

Currently, in the Republic of Kazakhstan, there is no system in place to provide assistance to patients in need of prolonged respiratory support on an outpatient basis as part of medical care. Meanwhile, the number of patients with Chronic respiratory failure (CRF) is steadily increasing, consisting of 5% all over the world.

Additionally, a majority of studies support the notion that providing home non-invasive ventilation (NIV) for a specific group of COPD patients results in notable cost savings and improved outcomes. On average, each patient saved £8254 (Euro 11,720) annually. Hospital stays decreased from 78 to 25 days, admissions reduced from 5 to 2, and ICU days decreased from 25 to 4 [11]. Overall, domiciliary NIV was effective in reducing admissions and costs, emphasizing its importance in COPD management and securing financial for such services [12, 13].

A systematic review investigating the effects of CPAP therapy on OSA revealed that successful treatment significantly reduced the risk of near-miss incidents and road traffic accidents (RTAs). The studies utilized a before-and-after comparison method, with control groups made up the general population. Almost all studies reported a considerable reduction, and in some cases, a complete normalization, of RTA risk following effective treatment [14].

## Tele-monitoring for homecare respiratory support

Tele-monitoring can be used along with initiating long-term NIV (LTNIV), which has been proven to be worth the cost for certain conditions like CRF caused by NMDs and other restrictive lung diseases [15]. Initiation of home mechanical ventilation at home: a randomised controlled trial of efficacy, feasibility and costs [16].

Studies indicate that tele-monitoring can reduce healthcare usage such as emergency visits and hospital admissions, and is cost-effective for patients with ALS [17]. According to the early studies have explored the potential for tele-monitoring to detect exacerbations of COPD in individuals using long-term NIV [13, 18].

The cost savings and improved clinical outcomes which are written above associated with using tele-monitoring for respiratory support in patients demonstrate its feasibility and effectiveness as a tool. Evidence from a group utilizing telemedicine showed an overall cost savings of $54,843.61 USD ($685.54 USD per patient per month) [19].

## Project of Homecare Respiratory Support in Kazakhstan

The planned project for the creation of a Centre for Homecare Respiratory Support will make possible to provide specialized medical care to patients suffering from severe CRF who require respiratory support on an outpatient basis with a 24-hour remote support service. Regular training will be provided for senior and mid-level medical professionals who provide long-term respiratory care in an outpatient setting.

The objectives of the project include the transfer of advanced international experience in the field of providing long-term respiratory support in outpatient settings, as well as professional training of senior and nursing staff, conducting training courses for doctors and nursing staff in the field of respiratory support, monitoring of outpatients on ventilation. The effectiveness of remote monitoring of respiratory support will also be assessed, clinical recommendations for the provision of long-term respiratory support in outpatient settings will be developed, and an optimal model of ambulatory centre for outpatient respiratory support will be created with its subsequent implementation in other regions of the country. The result of the project will be a significant improvement in the quality of life of patients, a reduction in the frequency and duration of hospitalizations, as well as a reduction in the social and financial burden on the healthcare system.

Based on our own clinical experience, as well as international experience in the use of various diagnostic options and respiratory support for patients with CRF, it is planned to purchase medical equipment, including consumables. Due to implement an action plan widely inform specialists of regional medical institutions and health authorities about the goals and objectives of the Homecare Respiratory Support Centre. To achieve this, it will be planned to hold several training conferences and seminars with the main subject experts at the regional and republican levels, and to use professional information portals and Internet resources. Information materials will be developed and created for doctors and patients, which will describe the principles of action, advantages, and clinical effects of the use of devices (invasive ventilation, non-invasive ventilation) of mechanical ventilation, as well as long-term oxygen therapy in patients with CRF. It is planned to establish professional contacts with clinic departments, pulmonologists, resuscitators, and family doctors to present our concept and identify patients in need of long-term respiratory support on an outpatient basis.

To obtain practical skills that are necessary to accompany patients receiving home respiratory support, it is planned to organize and conduct advanced training cycles for doctors and nursing staff with the involvement of leading domestic and foreign specialists. Currently, short-term courses of additional education are organized and conducted at our clinic. We have prepared short guides for doctors on sleep apnoea syndrome, non-invasive ventilation and bronchial drainage therapy. The next task necessary for the implementation of the Project is the selection of patients in need of long-term outpatient respiratory support. For this purpose, on a regular basis, consultations

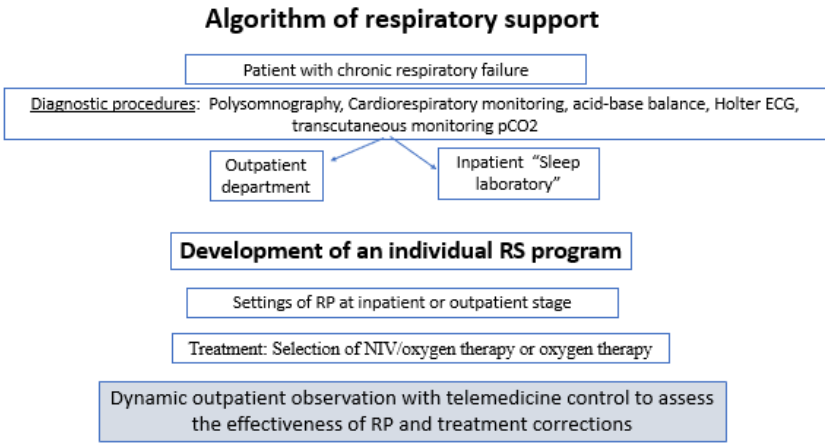


**Figure 2** – The algorithm of respiratory support for patients with chronic respiratory failure

with patients will be held at the outpatient centre of our clinic. Regular visits of Centre specialists to health care facilities in other regions of the country will be planned as well.

Based on the actual data obtained, action algorithms was developed for various situations that arise during remote monitoring of respiratory support carried out in an outpatient setting (Fig.2). It is planned that based on the results of two years of practical experience in the outpatient Respiratory Support Centre, a scientific assessment of the results of the treatment and diagnostic measures carried out and analysis of advanced international experience, we will develop clinical recommendations for the provision of long-term respiratory support in an outpatient setting.

In order to assess the medical and economic effect of long-term respiratory support in an outpatient setting, we plan to compare healthcare costs for patients receiving different types of respiratory support and those without it. Based on the results of the implementation and detailed critical analysis of the above tasks of our project, the optimal structure of the Centre for Outpatient Respiratory Support will be developed with a subsequent proposal to the Ministry of Health of Kazakhstan to open similar centres in other regions of the country.

The important prospect of the project is the inclusion of long-term respiratory support in the State volume of free medical care and further receipt of state subsidies to cover the costs of renting and maintaining artificial ventilation devices for patients with chronic respiratory failure in the Republic of Kazakhstan.

Successful implementation of homecare ventilation program will lead to a significant reduction in the financial burden of the state and society for the treatment of patients suffering from severe respiratory failure, improvement in the quality of life, reduction in the frequency and duration of hospitalizations (Fig. 3). Additionally, for patients with sleep apnoea, home respiratory support will lead to partial or full recovery of their working capacity, as well as a decrease in the frequency of road traffic accidents and industrial injuries.

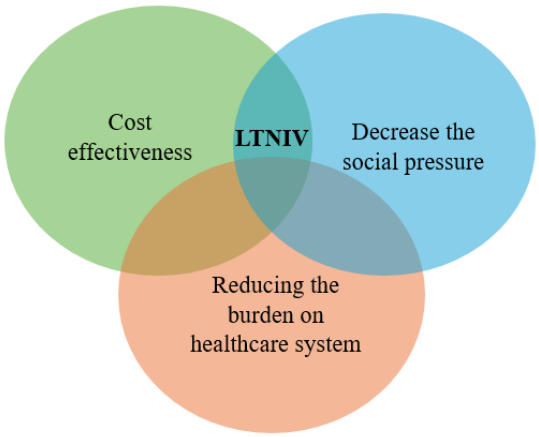


**Figure 3** – The interplay between cost-effectiveness, social tension, and the healthcare system culminates in the development of respiratory programs. LTNIV – long-term non-invasive ventilation

Long-term home care non-invasive ventilation can alleviate social pressure by allowing patients to remain at home, which is often their preferred option. This choice for home care provides a comfortable and familiar environment for patients, leading to improved overall well-being and increased adherence to therapy.

In conclusion, homecare respiratory support can significantly improve clinical and social outcomes, their work capacity, and reducing the need for hospitalizations of patients who suffer severe chronic respiratory failure.

## Abbreviations

ALS – Amyotrophic lateral sclerosis
ARDS – Acute respiratory distress syndrome
COPD – Chronic obstructive pulmonary disease
CRF – Chronic respiratory failure
CT – Computer tomography
GP – General practitioner
HRCT – High resolution computer tomography
ICU – Intensive care unit
LTNIV – Long-term non-invasive ventilation
NIV – Non-invasive ventilation
NMD – Neuromuscular disease
OSA – Obstructive sleep apnoea
QALY – Quality-adjusted life year
RS – Respiratory support
RTA – Road traffic accidents

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