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## **The role of prehabilitation in reducing the incidence of postoperative pulmonary complications in patients undergoing elective cardiac surgery: Results from the Pre Surgery Check Team study**

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# **The role of prehabilitation in reducing the incidence of postoperative pulmonary complications in patients undergoing elective cardiac surgery: Results from the Pre Surgery Check Team study**

**Short title:** Prehabilitation reduces pulmonary complications in cardiac surgery

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## **WHAT'S NEW?**

Pulmonary complications are common in patients undergoing open chest surgery and often affect the postoperative course. Comprehensive multimodal preoperative intervention (prehabilitation), consisting of improvement of physiological, nutritional and psychological status before planned surgery, can significantly reduce the risk of postoperative pulmonary complications and therefore shorten the intensive care unit length of stay. The participation of

the patient and his family in the multidimensional process of preparation for cardiac surgery significantly influences the immediate outcome of the operation. Considering the limited time available for prehabilitation, the combination of outpatient preoperative clinic and prehabilitation clinic seems to be an optimal solution for cardiac surgery centers. The model implemented in our hospital for all patients awaiting elective cardiac surgery is safe and effective.

## **ABSTRACT**

**Background:** Despite its importance, prehabilitation, has only been implemented in very few cardiac surgery centers.

**Aims:** The Pre Surgery Check Team study was designed to evaluate the impact of comprehensive interdisciplinary assessment and implementation of the prehabilitation program on the incidence of postoperative pulmonary complications after elective cardiac surgery.

**Material and methods:** 725 adult patients (338 in the study group, 387 in the control group) were included in this single-center, prospective, observational study. Multimodal prehabilitation consisted of four elements: interdisciplinary medical assessment by cardiologist, anesthesiologist and cardiac surgeon, pulmonary assessment for patients at high risk of postoperative pulmonary complications, psychological assessment, and physiotherapeutic assessment and training. The primary endpoint was the occurrence of the postoperative pulmonary complications, and the secondary outcomes were: surgical site infection, rethoracotomy, intensive care unit length of stay and hospital length of stay.

**Results:** Prehabilitation reduced the number of postoperative complications by 23%. Postoperative pneumonia was almost 3 times less common (5.33% vs. 14.21%), and the surgical site infection — 1.4 times less common in the PreScheck group (8.28 vs. 11.37%). In the logistic regression model, prehabilitation reduced the odds of postoperative pneumonia (by 0.346) and the odds of respiratory failure (by 0.479). Prehabilitation had no direct effect on intensive care unit length of stay.

**Conclusions:** Prehabilitation according to the Pre Surgery Check Team standard reduces the incidence of postoperative pulmonary complications and the total number of postoperative complications in patients undergoing elective cardiac surgery. The main benefit of attending the PreScheck Team visit is the opportunity to perform supportive preoperative interventions.

**Key words:** elective cardiac surgery, postoperative pulmonary complications, prehabilitation, PreScheck Team study

## **INTRODUCTION**

Pulmonary complications, such as pneumonia, prolonged mechanical ventilation and pleural effusions requiring drainage, are common in patients undergoing open chest surgery [1–3]. Postoperative pulmonary complications (PPCs) result in prolonged hospital stay and healthcare costs as well as increased morbidity and mortality after cardiac surgery [2]. The population of patients with cardiovascular disease listed for cardiac surgery has a high prevalence of advanced age, frailty, low cardiac fitness, and severe extracardiac comorbidities [4], which have been identified as predisposing to the development of PPCs. Prehabilitation is the process of improving physiological, nutritional and psychological status [5]. It has recently been identified as a research priority in adult cardiac surgery [6]. The Pre Surgery Check (PreScheck) Team combines traditional preoperative assessment with an outpatient prehabilitation clinic [4, 5].

Several meta-analyses of small clinical trials have shown that appropriately planned physical activity before cardiac surgery can reduce the risk of postoperative pulmonary complications and shorten the length of hospital stay [7–11]. The randomized controlled trial of exercise and inspiratory muscle training before cardiac surgery did not confirm the beneficial effect of physical training on exercise capacity or postoperative outcomes [12]. Physiotherapeutic assessment and implementation of respiratory exercises during the waiting period appears to be a crucial element of the preoperative patient management in cardiac surgery. However, prehabilitation is a multimodal process that includes not only physical training but also other important aspects such as optimization of comorbidities, nutritional intervention, smoking cessation and psychological support, the effects of which need to be investigated in future studies.

The main objective of this study was to evaluate the impact of comprehensive interdisciplinary assessment and implementation of the prehabilitation program by the Pre Surgery Check Team on the incidence of postoperative pulmonary complications after elective cardiac surgery.

## **MATERIAL AND METHODS**

This was a single-center, prospective, observational study conducted at the Department of Cardiac Surgery. The study population consisted of 725 adult patients (over 18 years of age) listed for elective cardiac surgery. The study group (PreScheck Team group) consisted of 338 consecutive patients (240 men, aged 29–81 years), who underwent surgery between January 1

and June 30, 2023 and underwent a comprehensive evaluation by the Pre Surgery Check Team 1-3 months prior to their planned cardiac surgery. The control group (No PreScheck Team group) consisted of 387 consecutive patients (275 men, aged 22–84 years), scheduled for elective cardiac surgery between March 1, 2022 and June 30, 2022, and January 1 and June 30, 2023, without preoperative multidisciplinary assessment. Exclusion criteria were: 1) eligibility for emergent/urgent cardiac surgery, 2) exclusion from cardiac surgery after personal evaluation of the patient by the medical team, and 3) death in the operating room. The flowchart of the study and control groups is summarized in [Figure 1](#).

The PreScheck Team started working in our hospital in October 2022 and all patients scheduled for elective cardiac surgery after January 1, 2023 were routinely referred for a pre-admission outpatient visit. All patients in the study group were thoroughly evaluated by the Pre Surgery Check Team during their 2-hour clinical appointments organized 1–3 months prior to their planned cardiac surgery. Patients in the control group were not seen by the multidisciplinary medical team prior to their planned surgery.

The PreScheck Team is an original concept that combines traditional preoperative evaluation and outpatient rehabilitation clinics [4, 5]. The PreScheck Team consists of the following components: 1) interdisciplinary personal medical assessment by cardiologist, anesthesiologist and cardiac surgeon who meet the patient and verify all data by physical examination; 2) pulmonary assessment (for patients with diagnosed chronic lung disease or high risk of postoperative pulmonary complications); 3) psychological assessment; 4) physiotherapeutic assessment and training [5].

[Figure 2](#) summarizes the organization scheme of the physiotherapy module. The interview collected during the physiotherapy visit included data on physical activity performed in the preceding period. For the majority of patients in the study group (301 patients, 89.05%), daily physical activity was low to moderate (PAL-physical activity level 1.3–1.7) [13]. However, the most important element of the physiotherapy module was the exercise instruction. The technique for performing the exercises was carefully explained to the patient and his relatives. Patients were given a booklet containing a series of general mobility and respiratory exercises (in the form of instructions with drawings). They were expected to perform seven exercises of their own choice at home for 20 minutes a day, without supervision, for 2 to 3 weeks prior to hospitalization. On admission to the hospital, patients were asked about their compliance with the recommendations, including the performance of the prescribed exercises, and all patients in the study group confirmed that they performed the exercises at home. An indirect way of verifying compliance with physiotherapy recommendations was that patients in

the study group cooperated well with staff during postoperative rehabilitation, confirming their familiarity with the exercises. Tolerance of home exercises and the occurrence of possible adverse effects of preoperative rehabilitation were assessed at hospital admission.

The following preoperative parameters were collected: age, sex, smoking status, body mass index, chronic respiratory comorbidities, other comorbidities (arterial hypertension, diabetes, atrial fibrillation, extracardiac arteriopathy), EuroSCORE 2 grade, left ventricular ejection fraction, glomerular filtration rate, and arterial gases. Nutritional assessment with Nutritional risk screening 2002 questionnaire was performed in all patients [14]. Nutritional advice/intervention was given to all patients at risk of malnutrition from the study group (Nutritional risk screening 2002 >2). The type of surgery (coronary artery bypass grafting, valve surgery, other types of surgery, combined surgery) was also taken into account. The primary endpoint was the occurrence of the PPCs: postoperative respiratory failure, pneumonia or pleural effusions requiring drainage. Postoperative pulmonary complications were defined according to the European guidelines for perioperative clinical outcome definitions [15]. Pleural effusion was assessed by chest X-ray or lung ultrasound [16], with cut-off volume of 300 ml as requiring drainage. Only PPCs meeting the objective criteria according to the guidelines were taken into account to eliminate bias. The following secondary outcomes were analyzed: surgical site infection, rethoracotomy, intensive care unit (ICU) length of stay and hospital length of stay.

## **Ethics**

The study protocol was approved by the local bioethics committee (decision number 1072.6120.78.2023). All study participants signed an informed consent form.

## **Statistical analysis**

Descriptive statistics for all our variables were performed using the PS Imago Pro 9 package (Predictive Solutions). Categorical variables were expressed as numbers and percentages, when the assumption for the  $\chi^2$  test was not met, the Fisher exact test was used to compare the groups. Continuous variables were expressed as mean (standard deviation) or median (interquartile range) and compared using t-Student's t-test or Mann–Whitney U test when appropriate.

Our data set includes information on 18 predictor variables and 35 explanatory variables. We chose to model and explain 7 variables: ICU length of stay, the presence of postoperative complications affecting at least 10% of patients, and the number of all postoperative complications considered for a given patient.

The initial statistical model for each of our 7 explained variables uses the same 35 potential determinants. Logistic regression was used for zero-one variables, Poisson regression for numeric variables [17]. In both types of models, we use maximum likelihood (ML) analysis as a tool for statistical inference [17]. All results discussed here were obtained using the Python module statsmodels.

Our main objective was to find the significant determinants (out of 35 initial explanatory variables) for each phenomenon to be modeled. The final statistical model for each explained variable was based on eliminating the “least significant” explanatory variables (and the intercept, if necessary) in several steps, where at each step the reduction of the initial model was checked using the likelihood ratio (LR) test. Such a procedure is stopped when the reduced model contains only significantly non-zero coefficients (with individual  $P$ -values less than 0.05) and the validity of all zero restrictions leading from the initial to the final model is confirmed by a sufficiently high  $P$ -value associated with the LR statistic. Recall that the asymptotic distribution of such an LR statistic is  $\chi^2$  with degrees of freedom equal to the number of zero restrictions imposed on the parameters in the initial model.

The main research question is whether prehabilitation was one of the significant determinants (i.e., the explanatory variable remaining in the final model) and whether the sign of the estimated coefficient indicates that the effect of prehabilitation was negative.

In the Results section, we present some important statistics for inference in the final models. For each variable, we show the ML estimate not for the original parameter, but for its functions, odds ratio in the case of the logit model, and the incidence rate ratio in the Poisson regression model. These ML estimates of odds ratio and incidence rate ratio are accompanied by the corresponding  $P$ -values and 95% confidence intervals.

## RESULTS

No adverse events related to the implementation of prehabilitation training were reported in the study group. The characteristics of both groups is summarized in [Table 1](#). Chronic lung disease was significantly more prevalent in the study group, but the proportion of patients with obesity was lower. Preliminary analysis indicates a different incidence of the 5 most common postoperative complications in the study and the control group ([Table 2](#)). For example, postoperative pneumonia is almost 3 times less common in the PreScheck group (5.33%) than in the control group (14.21%), and the surgical site infection is 1.4 times less common in the PreScheck group (8.28 vs. 11.37%). Since the patients within each of our two groups are very inhomogeneous, we must take into account all the available control variables in order to

eliminate their influence and isolate the “true” effect of prehabilitation. The proportion of patients with postoperative complications occurring together (at least two for one patient) is lower, and the proportion of patients without complications is higher in the PreScheck group. Only the proportions of patients with one complication are similar in both groups (Table 2).

### **Determinants of postoperative complications**

According to the final Poisson model, prehabilitation reduces the expected number of postoperative complications for a given patient (Table 3), being one of 16 determinants of the number of complications. Regarding particular postoperative complications, prehabilitation decreases the probability of postoperative pneumonia and respiratory failure. There were only 7 determinants for postoperative pneumonia and 9 determinants for respiratory failure (plus the significant intercept in both logit models), and prehabilitation was one of them in both cases (Table 4).

### **Determinants of the length of stay in ICU**

Table 4 summarizes important postoperative data for both groups. Length of hospital stay and ICU stay are not different between groups. However, the rates of in-hospital death, ICU stay, and hospital readmission are lower in the study group.

Since the length of ICU stay is at least one day, to use the standard Poisson regression model, our explanatory variable was defined as the number of days spent in the ICU minus one. The initial Poisson regression included all 35 preoperative explanatory variables. The direct role of prehabilitation in reducing ICU length of stay was not confirmed because the final model did not include our crucial variable (Table 5). There were 23 determinants of the length of ICU stay (plus the significant intercept), and prehabilitation was not one of them.

## **DISCUSSION**

The PreScheck Team study is the first clinical trial of this size to evaluate the impact of a multimodal 4-component structured prehabilitation program on the incidence of postoperative pulmonary complications in patients undergoing elective cardiac surgery. The total study population consisted of 725 patients (338 in the study group and 387 in the control group). The model implemented in our hospital since October 1, 2022 assumes that all patients awaiting elective cardiac surgery will eventually be included in the prehabilitation program [4, 5]. Currently approximately 100 patients per month are evaluated by the PreScheck Team prior to hospital admission. Due to the large number of patients and logistical constraints (e.g., the need



to use ward staff), an unsupervised home training model was used in the first phase of introducing prehabilitation as a standard of care (Figure 2). Despite these limitations, the results of the study are very encouraging. All postoperative pulmonary complications (respiratory failure, pneumonia, pleural effusion requiring drainage) were less frequent in the PreScheck group (Table 2). According to the logit model, the positive effect of prehabilitation was significant in the case of postoperative respiratory failure and pneumonia (Table 3). For the latter, prehabilitation reduces the odds of postoperative pneumonia by a factor of about 0.346 (all other characteristics held constant). Similarly, prehabilitation decreases the odds of postoperative respiratory failure by a factor of about 0.479.

Furthermore, in the parsimonious Poisson regression model, prehabilitation significantly reduced the expected number of postoperative complications for a given patient (Table 3). In our case, the expected number of postoperative complications for a given patient is approximately 23% lower if the patient has undergone prehabilitation (compared to a patient with exactly the same characteristics who did not undergo this procedure).

A number of small single-center trials of different types of prehabilitation before cardiac surgery, have reported up to a 50% reduction in postoperative pulmonary complications, reduced readmission rates and, in the elderly, reduced length of hospital stay [7–11]. The only two randomized controlled trials have focused on physical exercise and inspiratory muscle training [12, 18]. Patients eligible for coronary artery bypass grafting (CABG) were included in the study by Hulzebos et al. [18]. Preoperative, tailored, individualized inspiratory muscle training (IMT) reduced the incidence of PPCs and length of hospital stay in patients at high risk of developing pulmonary complications after CABG. In the study by Akowuah et al. [12] the combination of exercise and IMT before cardiac surgery was not superior to standard care in improving functional exercise capacity as measured by 6-minute walking test distance preoperatively. The authors reported no significant differences in postoperative surgical and pulmonary complications. Despite the conflicting results, both meta-analyses of small trials and sub-analyses of randomized trials show that the greatest benefit of prehabilitation is seen in the highest risk patients, i.e. older, less fit, very frail patients [8, 12, 19]. The next randomized multicenter controlled trial (PRECOVERY) was designed to evaluate the effectiveness of 2 weeks of inpatient multimodal prehabilitation for patients aged 75 years or older undergoing elective cardiac surgery [20].

Prehabilitation seems to be one of the main pillars of preoperative interventions to improve recovery after cardiac surgery. Unfortunately, despite strong interest, it has only been implemented in very few cardiac surgery centers [21]. This is most likely due to two reasons:

1) concerns about the safety of physical training in patients awaiting cardiac surgery and 2) the waiting time for surgery is too short to allow for prehabilitation. Several studies have shown that prehabilitation in the form of physical exercise and/or IMT is feasible and safe in cardiac surgery patients [12, 18, 19]. In our study, we also reported no adverse events related to the implementation of prehabilitation training. Considering the limited time available for prehabilitation, the PreScheck Team implemented in our center seems to be an optimal solution, because it combines both the pre-admission outpatient clinic and the prehabilitation clinic. It allows the multidisciplinary team to simultaneously assess and confirm the patient's eligibility for surgery and to perform prehabilitation to ensure optimal preparation for surgery.

In the study by Akowuah et al [12], about half of the patients declined to participate in exercise training due to travel constraints, and only 71% of the recruited patients attended at least half of the supervised exercise sessions. In our study 72.09% of patients listed for surgery since January 2023 attended at least one PreScheck Team visit. However, the percentage of patients attending an outpatient clinic is currently approximately 90% of all patients awaiting elective cardiac surgery. Feedback from PreScheck Team staff indicates that both patients and their families are enthusiastic about participating in prehabilitation. Patients and their relatives, who are always encouraged to accompany the patient during the PreScheck Team visit, particularly appreciate the opportunity to discuss their risk stratification data and treatment strategies with the multidisciplinary medical team. A visit to the prehabilitation clinic makes the patient aware that he or she is not just a subject, but also an equal partner in the treatment process. The main benefit of attending the PreScheck Team visit is undoubtedly the opportunity to perform supportive preoperative interventions. Reducing a patient's surgical risk is not only related to improving physical fitness and inspiratory muscle strength. There are other important elements such as optimizing co-morbidities, nutritional intervention, smoking cessation or reducing anxiety levels through psychological support.

The study has several limitations. First, the impact of disqualifying extremely high-risk patients during preoperative visit should also be considered. The main reason for permanent exclusion from cardiac surgery was unacceptably high operative risk associated mainly with advanced age, frailty, morbid obesity and pulmonary status. Second, only patients who were eligible for elective cardiac surgery were included in the study. Third, regardless of individual risk, all patients in the study group underwent the same prehabilitation model. The PreScheck Team prehabilitation model can be described as "interventional" prehabilitation, because it involves a single outpatient clinic visit for most patients prior to surgery. Future research should

focus on the effects of individualized prehabilitation over several weeks in the highest risk group of patients.

Prehabilitation according to the PreScheck Team model reduces the incidence of some postoperative pulmonary complications in patients undergoing elective cardiac surgery. The significant effect of prehabilitation on other postoperative data (like in-hospital deaths or ICU and hospital readmission rates) could also be expected; however, this is left to future research.

### **Article information**

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**Table 1.** Demographic and clinical characteristics of the study and the control groups

Characteristics	Study group (PreScheck Team group)	Control group (No PreScheck Team group)	<i>P</i> -value
Total number of patients, n	338	387	-
Male sex, n (%)	240 (71.01)	275 (71.01)	0.99

Cardiac surgery procedure, n (%)			
Coronary artery bypass grafting	146 (43.2)	159 (41.09)	0.57
Aortic valve surgery	140 (41.42)	166 (48.89)	0.69
Aortic procedure	29 (8.57)	36 (9.3)	0.73
Mitral valve surgery	46 (13.61)	48 (12.4)	0.63
Tricuspid valve surgery	16 (4.73)	23 (5.94)	0.47
Combined surgery	74 (21.89)	72 (18.6)	0.27
Other procedure	47 (13.91)	60 (15.5)	0.54
Age, years, mean (SD)	64.3 (9.67)	64.84 (10.99)	0.48
Age >65 years, n (%)	193 (57.1)	209 (54.01)	0.4
Age >70 years, n (%)	97 (28.7)	135 (34.88)	0.07
BMI, kg/m <sup>2</sup> , median (IQR)	27.76 (25.1–30.8)	29 (25.86–31.97)	0.75
BMI >30 kg/m <sup>2</sup> , n (%)	95 (28.11)	155 (40.05)	<0.001
LVEF, %, mean (SD)	54.88 (9.74)	55.16 (9.57)	0.7
LVEF ≤35%, n (%)	22 (6.51)	28 (7.24)	0.7
Prior cardiac surgery, n (%)	11 (3.25)	21 (5.41)	0.16
Smoking, n (%)	40 (11.83)	47 (12.14)	0.9
Coronary artery disease, n (%)	172 (50.89)	206 (53.23)	0.53
Arterial hypertension, n (%)	250 (73.96)	304 (78.55)	0.15
Chronic lung disease, n (%)	55 (16.27)	42 (10.85)	0.03
Diabetes, n (%)	139 (41.12)	147 (37.98)	0.39
Diabetes on insulin, n (%)	19 (5.62)	11 (2.84)	0.06
Extracardiac arteriopathy, n (%)	40 (11.83)	43 (11.11)	0.76
Atrial fibrillation, n (%)	62 (18.34)	77 (19.9)	0.6
EuroSCORE 2, median (IQR)	1.25 (0.89–1.85)	1.25 (0.87–2.06)	0.83
GFR, ml/kg/m <sup>2</sup> , median (IQR)	85 (61–95)	83 (65.75–96)	0.65
pCO <sub>2</sub> , mm Hg, mean (SD)	37.23 (4.12)	37.07 (3.57)	0.58
pO <sub>2</sub> , mm Hg, mean (SD)	91.9 (15.3)	91.52 (15.32)	0.74

Abbreviations: BMI, body mass index; EuroSCORE 2, European System for Cardiac Operative Risk Evaluation 2; GFR, glomerular filtration rate; IQR, interquartile range; LVEF, left ventricular ejection fraction; pCO<sub>2</sub>, partial pressure of CO<sub>2</sub>; pO<sub>2</sub>, partial pressure of O<sub>2</sub>

**Table 2.** Postoperative complications in the study and the control groups

Complications, n (%)	Study group (PreScheck Team group) (n = 338)	Control group (No PreScheck Team group) (n = 387)	<i>P</i> -value
Rethoracotomy	32 (9.47)	39 (10.08)	0.78
Respiratory failure	26 (7.7)	60 (15.5)	0.001
Postoperative pneumonia	18 (5.33)	55 (14.21)	<0.001
Pleural effusion requiring drainage	39 (11.54)	54 (13.95)	0.33
Surgical site infection	28 (8.28)	44 (11.37)	0.17
Acute kidney injury requiring dialysis	12 (3.55)	14 (3.62)	0.96
Gastric bleeding	7 (2.07)	7 (1.81)	0.8
Neurological complications	9 (2.66)	6 (1.55)	0.29
Pacemaker implantation	15 (4.44)	15 (3.88)	0.7
Number of patients with <i>m</i> complications:			<0.001
<i>m</i> = 0	223 (65.98)	220 (56.85)	
<i>m</i> = 1	73 (21.6)	81 (20.93)	
<i>m</i> ≥ 2	42 (12.43)	86 (22.22)	

**Table 3.** Determinants of selected postoperative complications — results from final models

Explanatory variable	Estimated IRR/OR	<i>P</i> -value	95% CI	
			0.025	0.975
Number of complications (Poisson regression)				
Congenital heart defect	5.551	<0.001	2.686	11.484
Percutaneous intervention	2.038	0.001	1.323	3.139
Prior cardiac surgery	1.956	<0.001	1.398	2.735
Other type of surgery	2.164	0.007	1.230	3.811
Atrial septal defect plasty	1.902	0.005	1.218	2.971
Ablation	2.272	0.001	1.420	3.636
Tricuspid valve plasty	1.994	<0.001	1.504	2.643

Aortic surgery	2.907	<0.001	2.083	4.055
Mitral valve surgery	1.929	<0.001	1.480	2.512
Aortic valve surgery	1.598	<0.001	1.245	2.052
Minimally invasive CABG	2.633	<0.001	1.790	3.877
CABG	1.454	0.004	1.131	1.868
<b>Prehabilitation</b>	<b>0.769</b>	<b>0.004</b>	<b>0.641</b>	<b>0.920</b>
pCO <sub>2</sub>	14.939	<0.001	3.861	57.858
pO <sub>2</sub>	0.482	0.006	0.287	0.808
GFR	0.165	<0.001	0.112	0.243
Postoperative pneumonia (logit model)				
Aortic surgery	2.915	0.004	1.399	6.074
Other types of surgery	4.904	0.017	1.324	18.174
Ablation	6.437	0.005	1.775	23.313
Tricuspid valve plasty	3.238	0.005	1.419	7.396
<b>Prehabilitation</b>	<b>0.346</b>	<b>&lt;0.001</b>	<b>0.195</b>	<b>0.612</b>
GFR	0.199	0.006	0.063	0.628
pCO <sub>2</sub>	1520.812	0.030	2.058	1123.546
Postoperative respiratory failure (logit model)				
BMI	16.379	0.041	1.124	238.411
Congenital heart defect	10.392	0.012	1.674	64.521
Percutaneous intervention	4.229	0.007	1.477	12.097
Tricuspid valve plasty	3.248	0.006	1.412	7.470
Minimally invasive CABG	4.154	<0.001	1.986	8.689
<b>Prehabilitation</b>	<b>0.479</b>	<b>0.007</b>	<b>0.282</b>	<b>0.815</b>
EuroSCORE 2 result	1.271	0.001	1.099	1.469
GFR	0.261	0.028	0.079	0.862
Chronic lung disease	2.349	0.007	1.266	4.357

Abbreviations: CABG, coronary artery bypass grafting; CI, confidence interval; IRR, incidence rate ratio; OR, odds ratio; other — see [Table 1](#)

**Table 4.** Postoperative hospitalization data of the study and the control groups evaluated by regression



Variable	Study group (PreScheck Team group) (n = 338)	Control group (No PreScheck Team group) (n = 387)	P-value
Period between PreScheck Team visit and surgery, days, median (IQR)	50 (23–79)	Not applicable	–
ICU length of stay, days, median (IQR)	1 (1–3)	1 (1–4)	0.8
Hospital length of stay, days, median (IQR)	9 (7–14)	8 (7–14)	0.82
ICU readmission, n (%)	7 (2.07)	27 (6.96)	0.001
Hospital readmission within 30 days after discharge, n (%)	13 (3.81)	27 (6.96)	0.07
In-hospital death, n (%)	6 (1.78)	18 (4.65)	0.03

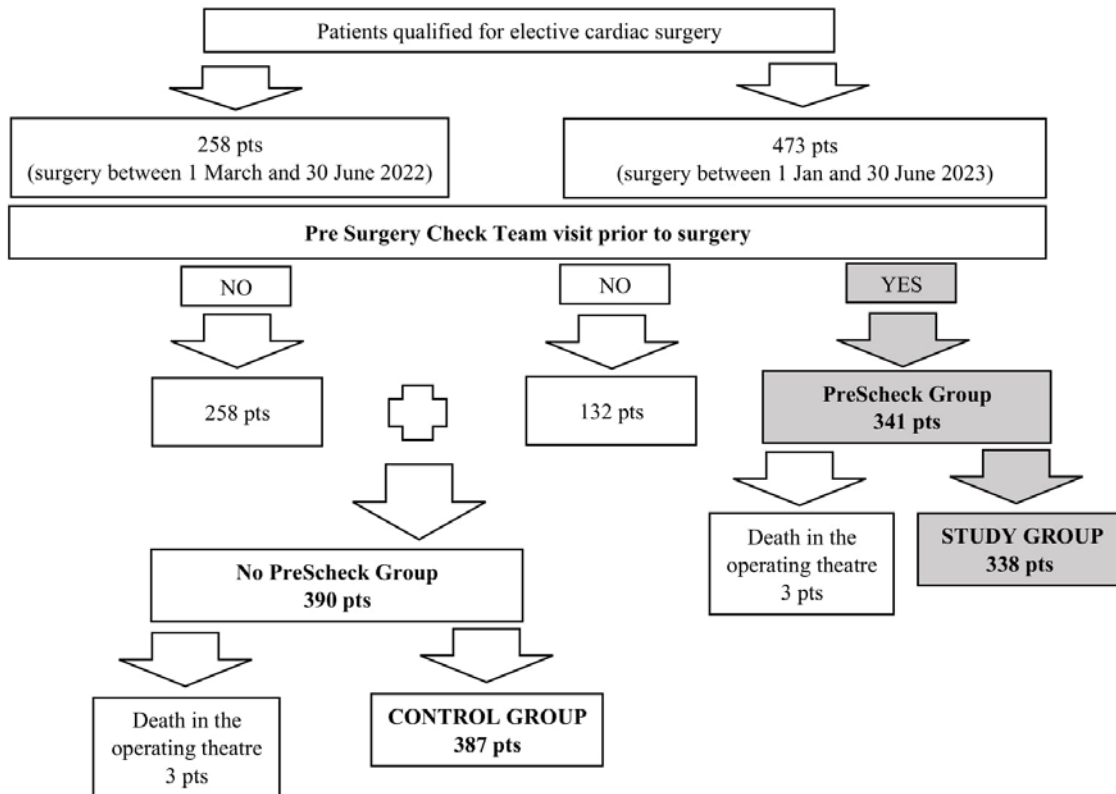
Abbreviations: ICU, intensive care unit; other — see [Table 1](#)

**Table 5.** Determinants of the number of additional days (above 1 day) spent in the , intensive care unit, assessed by Poisson regression

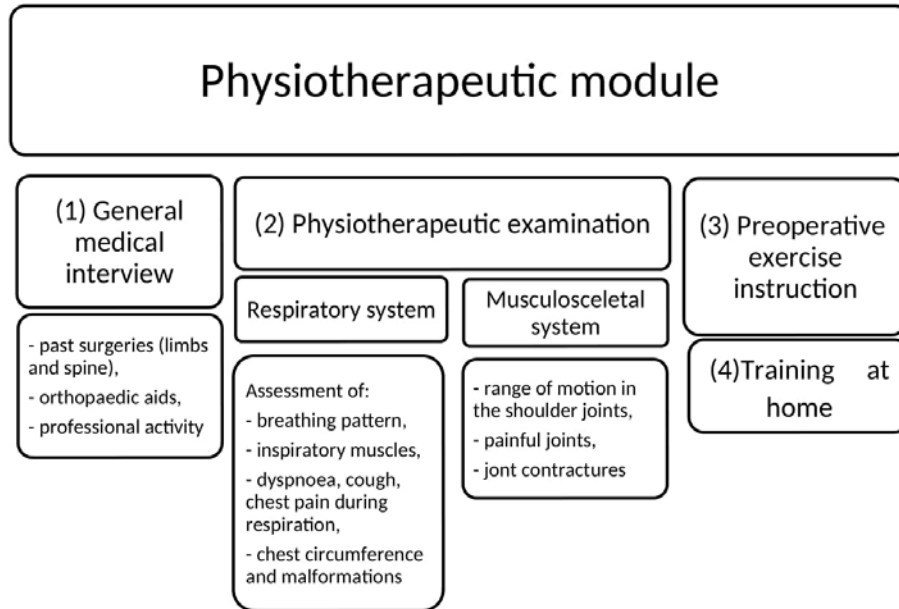
Explanatory variable	Estimated IRR	P-value	95% CI	
			0.025	0.025
Age	12.317	<0.001	4.855	31.249
Age >65 years	0.614	<0.001	0.524	0.720
Chronic lung disease	1.183	0.012	1.038	1.350
Diebetes	1.251	<0.001	1.130	1.387
Diabetes on insulin	0.624	<0.001	0.480	0.811
Coronary artery disease	1.247	0.005	1.068	1.455
pCO <sub>2</sub>	241.773	<0.001	78.649	742.483
BMI >30 kg/m <sup>2</sup>	1.242	<0.001	1.124	1.373
LVEF ≤35%	1.197	0.023	1.025	1.399
GFR	0.270	<0.001	0.209	0.348
EuroSCORE 2 result	1.058	<0.001	1.030	1.084
CABG	1.280	0.016	1.047	1.564
Minimally invasive CABG	2.547	<0.001	1.982	3.274
Aortic valve surgery	1.530	<0.001	1.311	1.784

Mitral valve surgery	1.244	0.020	1.036	1.493
Aortic surgery	3.089	<0.001	2.521	3.785
Tricuspid valve plasty	2.886	<0.001	2.447	3.401
Ablation	2.447	<0.001	1.937	3.089
Other surgery	3.725	<0.001	2.832	4.899
Combined surgery	1.573	<0.001	1.347	1.839
Percutaneous intervention	1.507	0.004	1.142	1.989
Congenital heart defect	8.298	<0.001	5.652	12.170
Prior cardiac surgery	2.319	<0.001	1.840	2.921

Abbreviations: see [Tables 1](#) and [3](#)



**Figure 1.** Flowchart of the study and control groups



**Figure 2.** Organization scheme of the physiotherapy module