# INDEPENDENT FINAL REPORT

# NON-INVASIVE AIRWAY CLEARANCE WITH THE FREQUENCER® FOR THE TREATMENT OF HOSPITALIZED COVID-19 PATIENTS IN QUEBEC

## June 30, 2021

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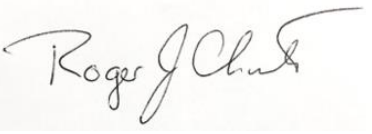
| **Report reviewed by** | Roger Chute, RRT |  | July 15, 2021 |

## EXECUTIVE SUMMARY

## NON-INVASIVE AIRWAY CLEARANCE WITH THE FREQUENCER® FOR THE TREATMENT OF HOSPITALIZED COVID-19 PATIENTS IN QUEBEC

The Frequencer®, a proprietary acoustic airway clearance technology developed by Dymedso, is approved for the treatment of respiratory diseases by regulatory authorities in Canada, the USA and Europe for safety and efficacy. The validated technology uses acoustic signals which have been optimized at a frequency of ~40 Hz to change the properties of mucus in the lungs, making it more fluid and easier to expectorate. The device thereby clears the airways non-invasively.

As the world is acutely aware, the respiratory pathogen causing COVID-19 can cause serious inflammation to the respiratory system, resulting in viral pneumonia and severe respiratory distress requiring mobilization of secretions in hospital wards or Intensive Care Units (ICUs) to rehabilitate oxygenation of the patient. Sadly, in a considerable number of patients, COVID-19 leads to acute respiratory distress syndrome (ARDS) and death. Reducing the build-up of mucus in the airways is required to reduce morbidity, mortality and use of medical resources, and to improve quality of life. The Frequencer® has been successfully adopted for treatment of COVID-19 in sites outside of Canada, providing safe, easy and consistent effective therapy for ICU patients.

To address the urgent need for airway clearance treatment of hospitalized COVID-19 patients in the province of Quebec, a non-comparative multicenter clinical-economic study as an addition to standard care was performed with the goals of demonstrating clinical relevance and economic efficacy. Multiple devices were placed in Quebec hospitals / ICUs during the period of October 2020 to June 2021, through a Province of Quebec funded initiative for the introduction of an approved medical device to assess the feasibility and economic potential of its use during the COVID-19 pandemic. Several outcomes were assessed after treatment with the Frequencer®, including physiological parameters (oxygen saturation, dyspnea or shortness of breath), patient reported satisfaction, economic parameters and therapist reported opinion. This information was collected via 3 separate questionnaires; a Patient Questionnaire, a Therapist Questionnaire and a Final Questionnaire completed by the Head of Respiratory Therapy at each site.

Approximately 108 patients were treated multiple times with the Frequencer® during the test period. Individual Patient Questionnaires were not completed for every patient due to staff shortages and lack of time to fill the questionnaires during the pandemic. However, it is quite remarkable that therapists and physicians were willing to adopt a new device during this time of extreme stress and pressure on healthcare workers. These professionals were very compliant and generous in filling in Therapist and Final Questionnaires. Apart from COVID-19 patients, patients with COPD (chronic obstructive pulmonary disease), pneumonia, bronchiectasis, neuromuscular disorders, and post-surgical patients were treated with the Frequencer®. Both intubated and non-intubated patients were treated.

The key study findings regarding the use of the Frequencer® are highlighted below:

| Patient and therapist reported satisfaction | Efficacy |
|---|---|
| • Very high general satisfaction (**above 4** on scale of 1 to 5) | • **70%** of patients showed an improvement in clinical status (improvement in dyspnea post *vs.* pre-treatment) |
| • Very comfortable (**above 4** on a scale of 1 to 5) | • **85%** of patients perceived that their respiratory condition improved (effective in clearing lungs and improved breathing) |
| • Very easy to use by therapists (**4.8** on a scale of 1 to 5) | • **All** therapists indicated that the Frequencer® improves the respiratory condition of patients |
| **Comparison to other airway clearance methods** | **Expected economic benefits **** |
| • **30% better** than the average* in ease of treatment (3.9 on a scale of 1 to 5) and **42%** better than average on patient comfort (4.25 on a scale of 1 to 5) | • **82%** of therapists and **100%** of department heads indicated the Frequencer® should curtail ICU admissions |
| • **27% better** than the average* in efficacy (3.8 on a scale of 1 to 5) from the therapist perspective | • **92%** of therapists and **100%** of department heads expect shortened hospital stay |
| • **27% better** than the average* in productivity gain (3.8 on a scale of 1 to 5) | • **83%** of therapists expect potential time savings resulting in better use of health professional time |
| • Patients were more compliant, uniformity of therapy was better and less patient mobilization was required | • **70%** of therapists expect a reduction in exposure to infectious patients |

** Average is defined as a rating of 3 on the scale of 1 to 5.*
*** If large scale deployment of the Frequencer® was implemented.*

In conclusion, the goals of this study were met and the Frequencer® was successfully integrated and adopted in multiple hospitals / ICUs in Quebec for the treatment of COVID-19 patients during the crises of the 2nd and 3rd waves of the pandemic. The device was found to be easy to use, effective and consistent at clearing pulmonary secretions. Additionally, it was found to be as good as or better than (nominally 30% better) other airway clearance methods. Having been able to employ the use of an unfamiliar device and obtain questionnaire data from medical staff during a pandemic is a strong demonstration of the value of the Frequencer®.

Furthermore, valuable economic data was collected that indicates that the use of the Frequencer® is expected to curtail admission to ICU, shorten overall hospital stays, reduce spread of infection and increase productivity. It is estimated that in Canada, a COVID-19 ICU hospital stay is $50K ($2.4K per day), while a non-ICU stay is $15K ($1.4K per day). Anything that can be done to prevent or reduce these numbers will have a large impact on healthcare costs, and more importantly, on patient quality of life. When all these benefits are added, a total savings (NPV) for the taxpayers of $21.1K to $24K per patient results. The data collected in this timely study should support adoption of the device more broadly across Canada and the world prior to the next COVID-19 wave due to variants.

## 1. INTRODUCTION

The Frequencer®, an airway clearance technology developed by Dymedso, is approved for the treatment of respiratory diseases by regulatory authorities in Canada, the USA and Europe. The patented technology uses acoustic signals to clear lung airways. The frequency of the acoustic waves is optimized at ~40Hz to effect change on mucus properties in the lungs, making it more fluid and easier to expectorate[1,2], thus clearing the airways non-invasively.

The clinical spectrum of COVID-19 is wide, encompassing asymptomatic infection, mild upper respiratory tract illness, and severe viral pneumonia with respiratory failure[3]. In a considerable number of cases, COVID-19 requires hospitalization, which may lead to acute respiratory distress syndrome (ARDS), and death[4,5]. The fatality rate of COVID-19 is largely dependent on the progression from mild to severe disease (73% of patients progress from mild to pneumonia), and capacity of hospitals to reduce the progression from pneumonia to severe ARDS (3-63% of patients progress from pneumonia to ARDS with 43% death rate from ARDS)[5]. Large amounts of sticky mucus and hyaline membranes in the deep-seated airways have been found upon autopsy in some patients[6], and a relationship has been shown between the viscosity of the sputum and the severity of illness[7]. As the disease progresses, sputum may gradually increase, and it is relatively sticky and difficult to expectorate without assistance[7]. Therefore, effective and early removal of mucus in the airway is critical to the prognosis of severely ill COVID-19 patients.

According to the guidelines on respiratory rehabilitation for patients with COVID-19, techniques such as chest percussion, vibration and postural drainage can be used to improve sputum retention and difficulty in sputum expectoration[8]. A non-invasive device that is compatible with ventilation that effectively clears airway secretions is extremely valuable. Additionally, a treatment modality that rapidly and effectively clears the airways of mucus and fluid and recruits smaller airways in the early stages of infection should alter the course and outcome of disease.

To address the critical need for airway clearance in the treatment of COVID-19, the Frequencer® was placed in 8 hospitals and 1 CHSLD (long-term care and housing center) in Quebec at the end of September 2020, through a Province of Quebec funded initiative for the introduction of an approved medical device to assess the feasibility and economic potential of its wider use during the COVID-19 pandemic. The primary aim of the project was to provide a validated, but largely unknown, tool for airway clearance in the treatment of COVID-19 patients during the pandemic. Additional goals included accumulating clinical and economic evidence including information on physiological parameters, patient reported opinion, economic parameters and therapist reported opinion to support adoption of the device more broadly across Canada and the world. Final results are presented in this report for the test period between October 2020 and June 2021 and an economic model is presented.

## 2. METHODS

Devices were shipped to 8 hospitals and 1 CHSLD in Quebec. After installation and training, the sites were requested to integrate the devices into the normal practice of treating patients requiring airway clearance, with a focus on COVID-19 patients.

An adaptation of the Delphi method[9] was utilized in this study. In the Delphi method, systematic and qualitative opinions are collected from a group of experts through several rounds of questions. The

method relies on the key assumption that forecasts from a group are generally more accurate than those from individuals. The aim of the Delphi method is to construct consensus forecasts from a group of experts in a structured iterative manner.

A Patient Questionnaire (see **Appendix A** for the template) and a Therapist Questionnaire (see **Appendix B** for the template) was provided and requested to be completed in real-time. Questionnaires were simple and direct and were designed to collect key data without imposing significant additional burden on healthcare teams during the pandemic and included information on the following parameters.

- Physiological parameters
  - Oxygen saturation, blood gases
  - Clinical condition of the patient (dyspnea)
  - Changes in ventilatory parameters (in the intubated patient and under mechanical ventilation)
- Patient Reported Opinion
  - General satisfaction (comparison with other treatments)
  - Impression of clinical improvement
- Economic parameters
  - Intensive care admission rate, duration of intubation (if applicable)
  - Length of stay (hospital, intensive care)
  - Time saving for the nursing staff
  - Reduction of risky interactions for caregivers
- Therapist Reported Opinion
  - Clinical efficacy
  - Economic efficiency (time saving)
  - Risk reduction for caregivers

A Final Questionnaire iteration was provided at the end of the test period to be completed by the Head / Designated Head of Respiratory Therapy from each site (see **Appendix C** for the template).

Data was entered into a database and a quality control review was performed by a second person. The results were reviewed, and descriptive statistics were performed. An economic model / payback analysis was also performed.

## 3. RESULTS OF QUESTIONNAIRES

### *3.1. Conditions Treated and Patient Demographics*

Data was recovered for approximately 108 patients treated with the Frequencer® during the test period from 6 hospital sites (2 hospitals and the CHSLD did not respond). However, this site response rate is high (67%), largely due to the methodology used and regular follow-up. The median reported patient age was 65 years (range of 21 to 89 years old), with equal distribution between genders. Information regarding conditions treated is summarized in **Table 1,** and included COVID-19, COPD (chronic obstructive pulmonary disease), pneumonia, bronchiectasis, neuromuscular disorders and post-surgical patients. Intubated and non-intubated patients were treated.

**Table 1:** Conditions treated with the Frequencer®.

| Condition | # patients | Additional information / Comments |
|---|---|---|
| COVID-19 | 35* | numbers reported by Head Respiratory Therapist; most of the patients were non-intubated |
| COPD exacerbation | 5 | |
| Pneumonia | 5 | 2 patients with accompanying bronchiectasis; 1 with accompanying COPD |
| Post-surgery | 4 | post lobectomy; post cardiac surgery; post aortic aneurysm resection (intubated); post op / post extubation |
| Neuromuscular | 2 | Multiple Sclerosis; Guillain Barre syndrome (intubated) |
| Other | 2 | stroke patient; patient with mucus plugs |
| Not specified | 55* | patients required airway clearance due to excessive secretion or blockage |

* Individual Patient Questionnaires were not completed for every patient in these categories due to staff shortages during the pandemic. The data was obtained from the head RT at the end of the study.

### *3.2. Patient Questionnaire Results*

#### *3.2.1. Physiologic parameters*

Oxygen ($O_2$) saturation and/or other gas exchange measures were reported to be improved for 41% of the patients, while there was no change in these parameters for the remainder of the patients, mostly because their $O_2$ saturation levels were already near normal at treatment onset. Most patients (70%) showed an improvement in clinical status (improvement in dyspnea).

#### *3.2.2. Patient-reported satisfaction*

Twenty-one (21) patients were able to give feedback on their treatments with the Frequencer®. Results are summarized in **Figure 1**. General satisfaction of the Frequencer® and comfort of treatment were rated very high (mean of 4.1 and 4.2, respectively, on a scale of 1 to 5). Patients felt the treatment was effective in clearing their lungs and that their breathing was improved (mean of 3.4 and 3.7, respectively, on a scale of 1 to 5). Eighty-five (85%) of the patients reported “yes” when asked if they had the impression of improved respiratory condition through use of the Frequencer®, specifying that it assisted with expectoration, released mucus plugs, and that they felt that they could breathe easier.

#### *3.2.3. Comparison to other airway treatments*

Twelve (12) patients reported experience in using other airway clearance techniques including endotracheal suctioning, respiratory physiotherapy, incentive spirometry, bronchoscopy and Aérobika. Of the patients that could rate the difference between the Frequencer® and other airway treatments: i) comfort of the Frequencer® was rated 42% better than average compared to other airway treatments, ii) efficiency of lung clearance was 10% better than average, and iii) ease of breathing was 17% better than average. Note that in this case average is defined as a rating of 3 on the scale of 1 to 5.

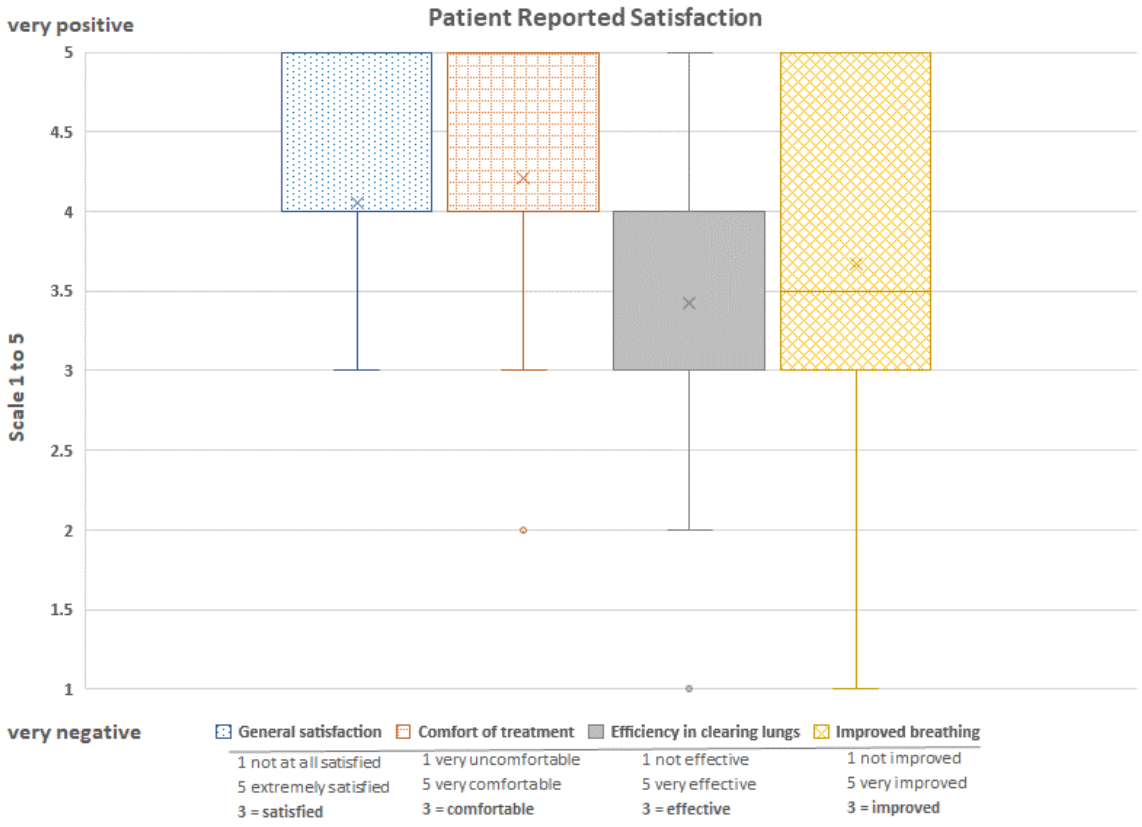



**Figure 1:** Results of patient-reported satisfaction. Distribution of data into quartiles is shown for each question on the Patient Questionnaire (scale of 1 to 5), highlighting the mean (X) and outliers (dots). The whiskers indicate variability outside the upper and lower quartiles.

### *3.3. Therapist Questionnaire Results*

#### *3.3.1. Efficacy, clinical indications, and economic benefits*

Fourteen (14) certified Inhalation Therapists completed the Therapist Questionnaire. All therapists indicated the Frequencer® improves the respiratory condition of some patients. The best clinical indications for Frequencer® treatment were reported as COVID-19, pediatric patients, COPD / chronic bronchitis, pneumonia, neuromuscular diseases / neuropathy, intubated patients, bronchiectasis, cystic fibrosis, and elderly patients.

Most therapists reported that economic benefits could be recognized by treatment with the Frequencer®, as summarized below.

- 82% of the therapists expect use of Frequencer® to reduce the rate of admission to intensive care.
- 67% therapists also indicated that the Frequencer® could contribute to faster improvement or extubation for critical care patients.
- 92% of therapists expect use of the Frequencer® to shorten hospital stays for patients with COVID-19, COPD, pneumonia, neuromuscular disease and intubated patients. It was also stated that use of the Frequencer® could prevent re-infection or superinfection.

- 83% of therapists indicated that the Frequencer® could save care staff time, particularly if the patient could use it autonomously. Two (2) therapists indicated that shorter hospitalizations would also save care staff time.
- 70% of therapists indicated that the Frequencer® could reduce personnel exposure to infectious patients.

### *3.3.2. Therapist-reported satisfaction*

Results of therapist-reported satisfaction are summarized in **Figure 2**. General satisfaction of the Frequencer® and comfort of treatment were rated very high by therapists (mean of 3.9 and 4.8, respectively, on a scale of 1 to 5), and the device was considered effective (mean of 3.2 on a scale of 1 to 5). Additionally, therapists felt that some time savings (mean of 3.1 on a scale of 1 to 5) could be recognized by use of the Frequencer®, especially when the patient could use the device autonomously. It was estimated that this savings could be between 10-20 minutes per patient per treatment.

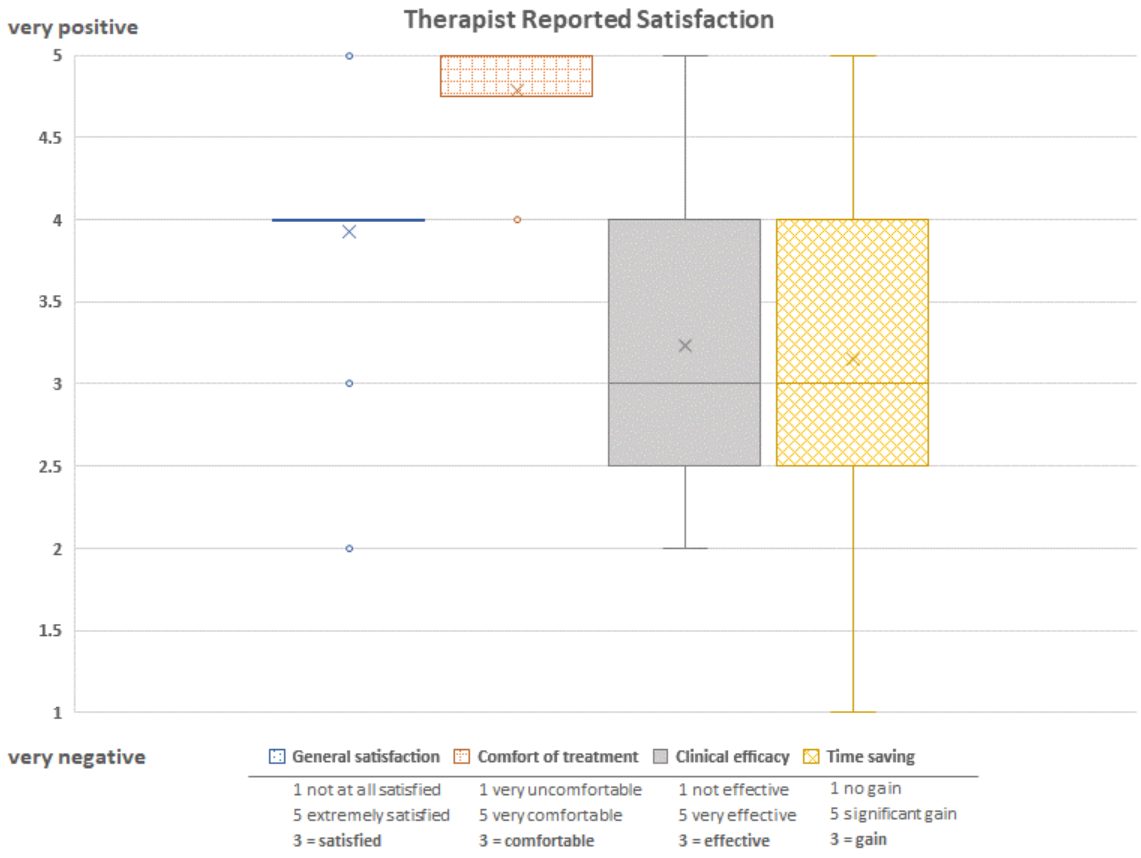



**Figure 2:** Results of therapist-reported satisfaction. Distribution of data into quartiles is shown for each question on the Therapist Questionnaire (scale of 1 to 5), highlighting the mean (X) and outliers (dots). The whiskers indicate variability outside the upper and lower quartiles.

### *3.3.3. Comparison to other airway treatments*

All therapists reported experience with other airway treatments, including clapping, "flutter", thoracic vibration/compression, assisted coughing/cough assist, Aérobika and IPV (Intrapulmonary Percussive Ventilator). Results of comparison of the Frequencer® to other airway treatments, as assessed by therapists are summarized in **Figure 3**. The Frequencer® was rated better in all areas including ease of treatment (30% better than average), efficacy (27% better than average) and productivity gain (27% better than average). Note that in this case average is defined as a rating of 3 on the scale of 1 to 5. Therapists also indicated that patients were more compliant with treatment, uniformity of therapy was better and less patient mobilization was required with the Frequencer®.

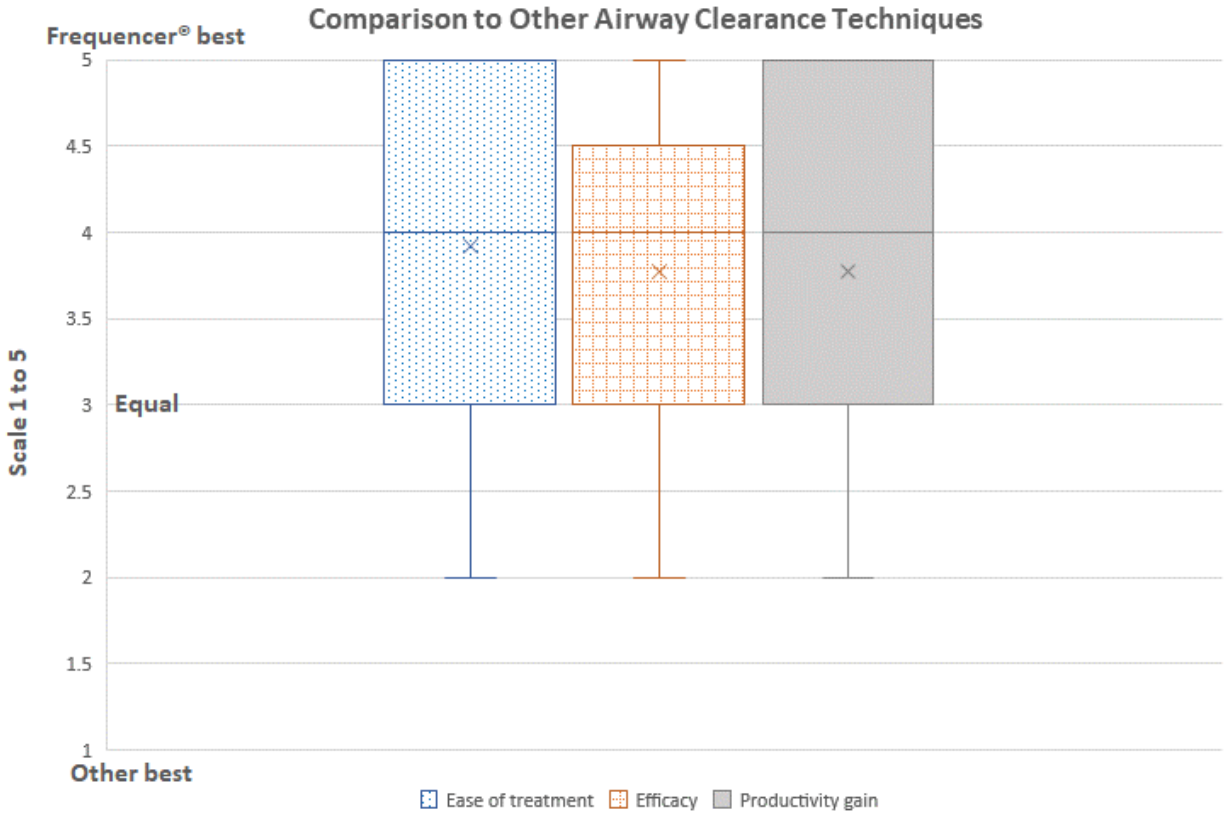



**Figure 3:** Results of therapist-reported comparison to other airway clearance techniques. Distribution of data into quartiles is shown for each question (scale of 1 to 5), highlighting the mean (X) and outliers (dots). The whiskers indicate variability outside the upper and lower quartiles.

### *3.4. Final Questionnaire Results*

Head Respiratory Therapists from 6 hospital sites completed the Final Questionnaire. All indicated that they would recommend use of the Frequencer®, and all, except one (who did not comment), indicated that the Frequencer® could reduce the rate of admission to intensive care or shorten length of hospitalization.

In the opinion of the department heads, the Frequencer® improved the respiratory condition of the patients. Specific comments are highlighted below.

- Improved expectoration capacity and reduced dyspnea for patients that had congested lungs but that could still expectorate.
- Better management of secretions.
- Multiple patients said they were able to clear their lungs after the treatment.
- Helped with clearing secretions.
- All patients were able to expectorate post-treatment. Some patients clearly stated that they thought the treatment was helpful.
- It is obvious that without the treatment their medical state would have deteriorated.

Head Therapist satisfaction results are reported in **Figure 4**. Feedback was positive; patients were very satisfied (mean of 4.2 on a scale of 1 to 5), the device was very comfortable (mean of 4.3 on a scale of 1 to 5), easy to use (4.8 on a scale of 1 to 5) and allowed for a better uniformity of treatment. One comment indicated that the device could get heavy when used for a long time, which could lead to discomfort in the professional's lower back.

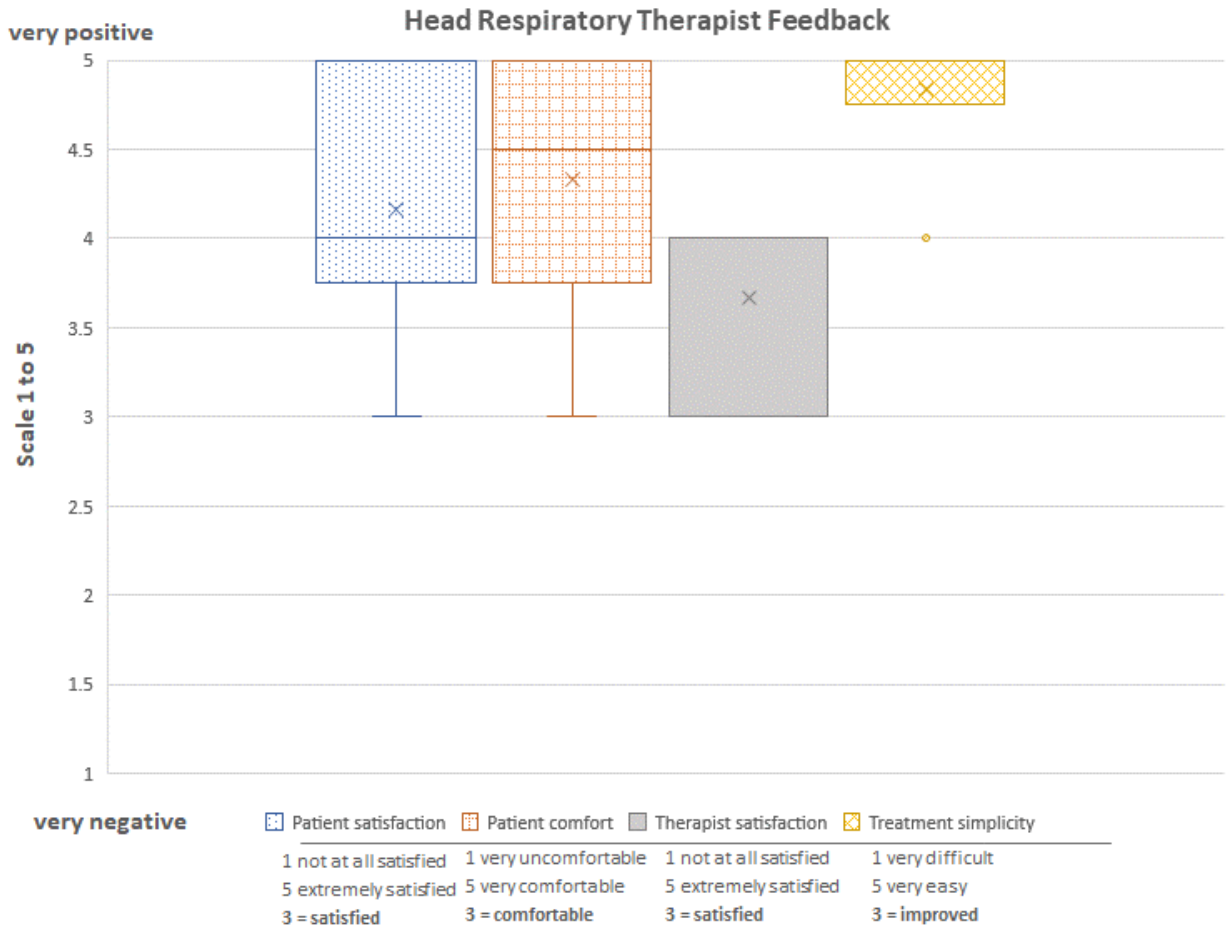



**Figure 4:** Results of feedback from the Head / Designated Head of Respiratory Therapy collected at the end of the test period. Distribution of data into quartiles is shown for each question (scale of 1 to 5), highlighting the mean (X) and outliers (dots). The whiskers indicate variability outside the upper and lower quartiles.

## 4. QUEBEC ECONOMIC ANALYSIS

### *4.1. Methodology and Data Consensus*

The Delphi method was used to perform the economic analysis and estimated payback ratio for the Frequencer® in this study. The Delphi forecasting tool, developed originally by the Rand Corporation for the military, has a long and successful history of practice, and has gained wide acceptance and use in the Business Management sector and health research[10]. This proven technique can be done either in person during interviews, which would be rather difficult in these infectious times, or though questionnaires. The method uses acknowledged experts to forecast on complex multivariate issues, and these forecasts are revisited or iterated by the same experts or by meta-experts up to convergence. In this case, all health centers where the Frequencer® was installed were associated to larger University health centers in Quebec and were experienced with clinical evaluation procedures facilitating the data gathering process. Additionally, highly trained Inhalation Therapists and Respiratory Therapists completed the Questionnaires. This method of forecasting is thus appropriate to that of this complex 6 hospital, multi-therapist setting, complicated further by the COVID-19 pandemic.

The present analysis aims to quantify the economic case for the use of the Frequencer® during pandemics and offer estimates regarding the non-pandemic use of the medical device. The economic value is also presented using the common form of the recognized Payback Ratio for the device and on the Net Present Value (NPV).

The expected benefits of the Frequencer® were separated in three categories: i) Can the device reduce the passage of patients from hospital ward to the ICU? ii) Can it shorten length of hospital stays? and iii) Does it represent an improvement in productivity? Added to these were indirect factors and benefits about the potential for spreading the disease to medical staff and other non-COVID-19 patients and efficacy of the Frequencer® compared to other airway clearance devices and methods used within the health centers.

The convergences reported are highly significant, represent clear feedback with low noise, and a high degree of cohesion. The following data were extracted from the previous section of the report.

- Questions regarding reduced demand for transition from hospital wards and ER to the ICU resulted in a strong 82-100% score, respectively by therapists and department heads, in favor of the Frequencer®. Data shows that 30.5% of Quebec's COVID-19 hospitalized patients will require treatment in ICU[11]. Comparatively, in Ontario the same source states a near 100% transition rate and Alberta shows a 29% rate in transition[11].
- 92% of the therapists and 100% of the head therapists believe the Frequencer® will result in shortened hospital stays.
- On the improvement of productivity, the results were offered only by the therapists and represent an 82% vote in its favor. The level of better productivity is evaluated at 27%. A similar question resulted in a similar score, of 30%, for the improvement in efficacy. The recovery of these estimates validate the process used for questioning the professionals.

Two additional questions provide substantial indirect economic value:

- 70% of the respondents expect that the use of the Frequencer® will reduce the risk of infections.

- The non-invasive nature of treatment with the Frequencer® treatment can be performed while a patient is intubated; this in 100% of the responses.

### *4.2. Economic Valuation of the Benefits*

Data in Section 4.1 was used to perform an economic analysis of the benefits on a per patient basis.

Regarding **reduction of hospital stays**, at $2.4K/patient/day for the ICU ($50K total)[12], the sum of savings is = 30.5% * ICU days saved. The Delphi summary indicates that between 82-100% of the patients will not require ICU and 92-100% will be discharged earlier from the hospital wards, without any quantification. Considering that 75% of the ICU patients will have ARDS[13], the economic savings are forecasted, neglecting the reduction in ward stays for the moment, to be at least between $10.5K and $11.4K per patient.

The **rate of personnel infection** is also significant. 70% of the health professionals believe that infections will be avoided. Using a conservative salary base of $60-80K/year/Health Care specialist with an estimated ratio of a specialist per patient on average and a rate of transmission (r0) of 1.2, this represents $3K to $4K/patient. Considering replacement professionals, the amount is double, or $6 to $8K/patient hospitalized.

**Productivity gains** were evaluated with two questions with alignment of coherent data at 27-30%. This amount is used to project the number of ward days saved per patient. Under COVID-19, the average ward stay is 11 days at $1.4K/patient/day[12]. This represents a savings of $4.6K/patient hospitalized.

When all these benefits are added, a **total savings (NPV) for taxpayers of $21.1K to $24K/patient** results. The cost for a Frequencer® in Canada is ~$15K. Thus, the payback period for each device is estimated at 0.6 to 0.7 of the patient's expected stay period which is 11 days. The payback period for the Frequencer® in a Quebec health care center is approximately ½ a month. In other words, for each patient treated for COVID-19 in Quebec Hospitals, about 2 Frequencer® devices could be purchased. The same benefits are expected for any ICU stay related to respiratory disease.

## 5. DISCUSSION AND CONCLUSIONS

The Frequencer® was successfully integrated and adopted in multiple hospitals / ICUs in Quebec for the treatment of COVID-19 patients during the period of October 2020 to June 2021. In addition to COVID-19, the devices were used on other patients requiring airway clearance, including successful use post-surgery and on intubated patients, demonstrating the broad utility of the therapy. It is quite remarkable that therapists and physicians were willing to adopt this unfamiliar device and use it on at least 108 patients during this time of extreme stress and pressure on healthcare workers due to the 2nd and 3rd waves of the pandemic (see **Figure 5**).

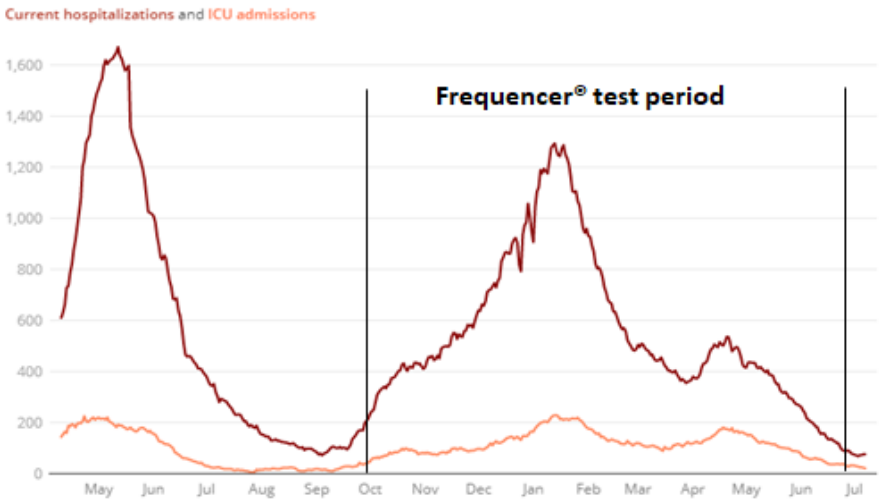



**Figure 5:** Hospitalizations (upper trace) and ICU admissions (lower trace) in the Province of Quebec due to COVID-19. The Frequencer® test period is indicated (October 2020 to June 2021). Graph produced by the CBC; Source INSPQ (https://www.inspq.qc.ca/covid-19/donnees).

Feedback from patients, therapists and department heads was overwhelmingly positive, and the device was effective and consistent at clearing pulmonary secretions. Remarkably, 70% of patients treated with the Frequencer® showed an improvement in clinical status and 85% of patients had the impression of improved respiratory condition including improved expectoration capacity and reduced dyspnea. Additionally, the Frequencer® rated better than other airway clearance techniques with regards to ease of treatment, efficacy and productivity gain. Therapists also indicated that patients were more compliant with treatment, uniformity of therapy was better and less patient mobilization was required with the Frequencer®. Furthermore, 70% of therapists indicated that the Frequencer® could reduce personnel exposure to infectious patients, an extremely important factor to consider during the COVID-19 era.

Most therapists and all department heads reported the device has the immediate potential to shorten hospital stays or prevent entry to ICU. Canadian data indicates that a COVID-19 ICU hospital stay is $50K ($2.4K per day), while a non-ICU stay is $15K ($1.4K per day)[12]. Additionally, COVID-19 hospitalizations tend to be longer than average[2]. Thus, use of the Frequencer® has the potential to significantly reduce the burden on the healthcare system and improve quality of life. When all these benefits are added, a total savings (NPV) for taxpayers of $21.1K to $24K/patient is expected.

In conclusion, the Frequencer® has been successfully adopted for treatment of COVID-19. It is highly significant that a new device was adopted so quickly by medical professionals. Sadly, unvaccinated communities could see a spike of COVID-19 cases in the Fall as the delta variant spreads across the world. This variant is as much as 60% more transmissible than the initial form of COVID-19 and is believed to have an increased risk of hospitalization[14]. Additionally, it is expected that the long-term effects in post-COVID-19 (or long-COVID) cases, estimated at 23% of all COVID-19 cases[15], will include increased susceptibility to airway clearance complications[16,17]. Therefore, wide adoption of this treatment is strongly suggested in Canadian hospitals and abroad prior to the next wave of COVID-19.

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## APPENDIX A

**FORMULAIRE À COMPLÉTER AVEC UN PATIENT APRÈS QUELQUES TRAITEMENTS:**

EST-CE QUE LE FREQUENCER A PERMIS UNE AMÉLIORATION DE :

LA SATURATION D'OXYGÈNE? : OUI NON
Détails : _____

AUTRES ÉCHANGES GAZEUX? (Par ex. ETCO2): OUI NON JE NE SAIS PAS
Détails : _____

L'ÉTAT CLINIQUE DU PATIENT? OUI NON
Détails : _____

DES PARAMÈTRES VENTILATOIRES (si intubé)? OUI NON
Si oui, comment ? : _____

AUTRES COMMENTAIRES/OBSERVATIONS : _____
_____

SATISFACTION RAPPORTÉE PAR LES **PATIENTS** :

**Satisfaction générale des traitements reçus avec le Frequencer :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Pas du tout satisfait | 1 | 2 | 3 | 4 | 5 | Extrêmement satisfait |

**Confort du traitement avec le Frequencer :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Très confortable | 1 | 2 | 3 | 4 | 5 | Très inconfortable |

**Efficacité à dégager les poumons :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Pas efficace | 1 | 2 | 3 | 4 | 5 | Très efficace |

**Amélioration de la respiration :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Pas amélioré | 1 | 2 | 3 | 4 | 5 | Très amélioré |

EST-CE QUE LE PATIENT RAPPORTE UNE IMPRESSION D'AMÉLIORATION DE SON ÉTAT RESPIRATOIRE PAR L'UTILISATION DU FREQUENCER? OUI NON
Commentaires : _____

**Avez-vous utilisé d'autres traitements de dégagements des voies respiratoires? Si oui, lequel?**

_____.

**Comment le Frequencer se compare-t-il à ce traitement?**

**Confort du traitement :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Autre meilleur | 1 | 2 | 3 | 4 | 5 | Frequencer Meilleur |

**Efficacité à dégager les poumons :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Autre meilleur | 1 | 2 | 3 | 4 | 5 | Frequencer Meilleur |

**Amélioration de la respiration**

| | | | | | | |
|---|---|---|---|---|---|---|
| Autre meilleur | 1 | 2 | 3 | 4 | 5 | Frequencer Meilleur |

Voudriez-vous pouvoir utiliser le Frequencer à domicile?

Oui, Pourquoi? _____

Non, Pourquoi? _____

AUTRES COMMENTAIRES/OBSERVATIONS :_____
_____
_____

**INFORMATION GÉNÉRALE :**

AGE DU PATIENT : _____ANS
SEXE : M F ND

DIAGNOSTIC RESPIRATOIRE :
COVID-19 OUI NON
AUTRE : _____

DATE : _____/_____/_____

NOM DU PROFESSIONNEL DE LA SANTÉ : _____

TITRE : INHALO PHT/TRP AUTRE : _____

## APPENDIX B

### FORMULAIRE À REMPLIR PAR CHACUN DES SOIGNANTS APRÈS UNE CERTAINE EXPÉRIENCE D'UTILISATION DU FREQUENCER$^{MD}$ (QUELQUES SEMAINES À UN MOIS) :

NOM DU PROFESSIONNEL DE LA SANTÉ : _____
TITRE : INHALO PHT/TRP AUTRE : _____
ÉTABLISSEMENT DE SANTÉ : _____

SELON VOUS, EST-CE QUE L'UTILISATION DU FREQUENCER PERMET D'AMÉLIORER L'ÉTAT RESPIRATOIRE DE CERTAINS PATIENTS? OUI NON

SI OUI, CHEZ QUEL TYPES DE PATIENTS/PATHOLOGIES EN PARTICULIER? :_____
_____

SELON VOUS, PENSEZ VOUS QUE L'UTILISATION DU FREQUENCER PUISSE RÉDUIRE LE TAUX D'ADMISSION AU SOINS INTENSIFS CHEZ CERTAINS PATIENTS? OUI NON

SI OUI, LESQUELS : _____

SELON VOUS, PENSEZ-VOUS QUE L'UTILISATION DU FREQUENCER PEUX CONTRIBUER À UNE AMÉLIORATION OU UNE EXTUBATION PLUS RAPIDE POUR LES PATIENTS AUX SOINS INTENSIFS?
OUI NON
COMMENTAIRES : _____

SELON VOUS, PENSEZ-VOUS QUE L'UTILISATION DU FREQUENCER POURRAIT CONTRIBUER À RACCOURCIR LE SÉJOUR HOSPITALIER DE CERTAINS PATIENTS? OUI NON
SI OUI, LESQUELS : _____

SELON VOUS, QUELLES SERAIENT LES MEILLEURES INDICATIONS CLINIQUES À L'UTILISATION DU FREQUENCER (LÀ OÙ LE BÉNÉFICE SERAIT LE PLUS GRAND) ? : _____
_____

SELON VOUS, QUAND LE PATIENT PEUT COOPÉRER, EST-CE QUE LE FREQUENCER PEUX PERMETTRE DE SAUVER DU TEMPS AU PERSONNEL SOIGNANT?_____
_____

SI OUI, AVEZ-VOUS UNE ESTIMATION DU TEMPS SAUVÉ PAR PATIENT? _____

SELON VOUS, QUAND LE PATIENT PEUT COOPÉRER, EST-CE QUE L'UTILISATION DU FREQUENCER À LA PLACE DU CLAPPING OU D'UNE AUTRE MÉTHODE DEDÉGAGEMENT DES VOIES RESPIRATOIRES PEUX PERMETTRE DE RÉDUIRE L'EXPOSITION DU PERSONNEL À DES PATIENTS INFECTIEUX? OUI NON

**FORMULAIRE À REMPLIR PAR CHACUN DES SOIGNANTS (SUITE)**

**Satisfaction générale des traitements avec le Frequencer :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Pas du tout satisfait | 1 | 2 | 3 | 4 | 5 | Extrêmement satisfait |

**Facilité du traitement avec le Frequencer :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Très facile | 1 | 2 | 3 | 4 | 5 | Très difficile |

**Impression de l'efficacité clinique :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Pas efficace | 1 | 2 | 3 | 4 | 5 | Très efficace |

**Gain de temps par rapport autres traitements (e.g. clapping) – sans tenir compte du temps à remplir les questionnaires de l'étude SVP :**

| | | | | | | |
|---|---|---|---|---|---|---|
| Pas de gain | 1 | 2 | 3 | 4 | 5 | Gain important |

**Utilisez-vous d'autres traitements de dégagements des voies respiratoires? Si oui, lequel?**

_____

**Comment le Frequencer se compare-t-il à ce traitement?**

Facilité du traitement :

| | | | | | | |
|---|---|---|---|---|---|---|
| Autre meilleur | 1 | 2 | 3 | 4 | 5 | Frequencer Meilleur |

Efficacité :

| | | | | | | |
|---|---|---|---|---|---|---|
| Autre meilleur | 1 | 2 | 3 | 4 | 5 | Frequencer Meilleur |

Gain de productivité :

| | | | | | | |
|---|---|---|---|---|---|---|
| Autre meilleur | 1 | 2 | 3 | 4 | 5 | Frequencer Meilleur |

Autres avantages ou problèmes rencontrés avec le Frequencer :

_____

_____

Pour tout autre commentaire, vous pouvez communiquer avec l'équipe scientifique de Dymedso aux coordonnées suivantes :

Dr. Simon Phaneuf

simon.phaneuf@dymedso.com

Portable : 418-355-7151

Permettez-vous à l'équipe scientifique de Dymedso de pouvoir communiquer avec vous? (Ceci serait seulement en cas de questions par rapport à ce questionnaire et vos informations personnelles seront gardées confidentielles et ne seront pas partagées ou utilisées à d'autres fins) : OUI NON

SI OUI, COMMENT?

NOM : _____

COURRIEL : _____

TÉLÉPHONE : _____

Merci de votre collaboration précieuse!

## APPENDIX C

### TEST DU FREQUENCER® POUR TRAITER LES PATIENTS COVID-19 HOSPITALISÉS

Objectif : Démontrer la pertinence clinique de la technologie acoustique pour dégager les voies respiratoires des patients COVID-19 hospitalisés.

**FORMULAIRE À REMPLIR AVEC LE CHEF / CHEF DÉSIGNÉ DE THÉRAPIE RESPIRATOIRE**

1. Nom et titre du professionnel de la santé : _____

2. Établissement de santé : _____

3. Combien de patients COVID-19 ont été traités avec le Frequencer® ? _____

4. Combien de patients ont été intubés ? _____

5. À votre avis, l'utilisation du Frequencer® a-t-elle amélioré l'état respiratoire des patients traités (c.-à-d. saturation en O2, autres échanges gazeux, paramètres ventilatoires, meilleure expectoration, état clinique global, sensation par le patient d'une respiration plus facile, amélioration de la couleur) ?

_____

_____

6. Pensez-vous que l'utilisation du Frequencer® peut réduire le taux d'admission en réanimation ou raccourcir la durée d'hospitalisation des patients ?

_____

_____

7. Sur une échelle de 1 à 5, 1 étant pas du tout satisfait et 5 étant extrêmement satisfait, quelle a été la satisfaction générale du patient vis-à-vis du traitement avec le Frequencer® :

Pas du tout satisfait 1 2 3 4 5 Extrêmement satisfait

8. Sur une échelle de 1 à 5, 1 étant très inconfortable et 5 étant très confortable, quel a été le confort de traitement du patient avec le Frequencer® :

Très inconfortable 1 2 3 4 5 Très confortable

9. Sur une échelle de 1 à 5, 1 étant pas du tout satisfait et 5 étant extrêmement satisfait, quelle est votre satisfaction générale du traitement avec le Frequencer® :

| | | | | | | |
|---|---|---|---|---|---|---|
| Pas du tout satisfait | 1 | 2 | 3 | 4 | 5 | Extrêmement satisfait |

10. Sur une échelle de 1 à 5, 1 étant très difficile et 5 étant très facile, comment évalueriez-vous la facilité du traitement avec le Frequencer® :

| | | | | | | |
|---|---|---|---|---|---|---|
| Très difficile | 1 | 2 | 3 | 4 | 5 | Très facile |

11. Les patients utilisaient-ils indépendamment le Frequencer® pour leur traitement? _____

12. Avez-vous d'autres commentaires concernant les avantages ou les problèmes rencontrés avec le Frequencer® ou les résultats du traitement ?

_____

_____

13. Recommanderiez-vous l'utilisation du Frequencer® ? _____

DATE: _____/_____/_____ SIGNATURE: _____