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Mise en œuvre d'un plan organisationnel pédiatrique adapté aux épidémies de bronchiolite

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FACULTE DE MEDECINE MONTPELLIER-NIMES

THESE

Pour obtenir le titre de

DOCTEUR EN MEDECINE

Présentée et soutenue publiquement

David LAVILLEDIEU

Le 16 octobre 2018

TITRE :

**Mise en œuvre d'un plan organisationnel pédiatrique adapté aux
épidémies de bronchiolite**

Directeur de thèse : Mr le Docteur Pascal AMEDRO

JURY :

Président :

Pr Nicolas SIRVENT, Professeur des Universités, département de pédiatrie, CHU Arnaud de Villeneuve, Montpellier

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Dr Pascal AMEDRO, Praticien Hospitalier, département de pédiatrie, CHU Arnaud de Villeneuve, Montpellier.



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TABLE DES MATIERES :

INTRODUCTION.....	20
METHODS	21
Study design and population.	21
The organizational infrastructure pediatric plan (OIPP).....	22
Study outcomes.....	25
Formal aspects.....	25
Statistical analysis	26
RESULTS.....	26
DISCUSSION.....	28
Study limitations.....	31
CONCLUSION	31
Acknowledgments.....	31
REFERENCES.....	32
TABLE AND FIGURE.....	36
Table 1: Assessment of bronchiolitis severity.....	36
Table 2: Comparison of outcomes between period 1 (before OIPP) and period 2 (OIPP)	37
FIGURES LEGENDS.....	38
Figure 1: Organization diagram before and after the OIPP.....	39
Figure 2: The OIPP stratification into 4 levels of care	40
Figure 3: Evolution of the distribution of hospitalization length for bronchiolitis within each unit over time.....	41
ANNEXE.....	42

ABSTRACT.....	43
SERMENT.....	44
RESUME :.....	46

**Mise en œuvre d'un plan organisationnel pédiatrique adapté aux
épidémies de bronchiolite**

**Implementation of an organizational infrastructure pediatric plan
adapted to bronchiolitis epidemics**

LIST OF ABBREVIATIONS

CIM-10: 10th revision of the International Classification of Diseases

CNIL: Commission Nationale de l'Informatique et des Libertés

ER: emergency room

HI-ICU: high-intensity medical intensive care unit

LI-ICU: low-intensity medical intensive care unit

N-ICU: neonatal medical intensive care unit

NIV: non-invasive ventilation

OIPP: organizational infrastructure pediatric plan

PMSI: Programme de Medicalisation des Systemes d'Information

RSV: Respiratory syncytial virus

SpO2: Oxygen saturation

INTRODUCTION

Acute bronchiolitis is a viral respiratory infection affecting the smaller bronchial tubes. The virus most often involved is the respiratory syncytial virus (RSV).¹ It is a major cause of lower respiratory tract infections and hospital visits during infancy and childhood. In the United States, about one among five children is admitted in a pediatric unit within his first year of life as a result of RSV bronchiolitis.² In 2009, bronchiolitis accounted for 130,000 hospitalizations, with a total cost of approximately 550 million dollars. In France, the bronchiolitis epidemic season has progressively increased, being responsible for 460,000 new cases per year.³ Now, bronchiolitis epidemics represents 12% of the emergency rooms' admissions and 27% of hospitalizations,⁴ and therefore leads to recurrent hospital disruption. The current trend towards a reduction of hospital beds is exacerbating the pressure of bronchiolitis epidemics on healthcare systems.

Despite the significant impact of this disease, few therapeutic strategies have been effective. Indeed, the current guidelines about bronchiolitis management did not reduce the massive influx of patients during epidemic periods. The management of children hospitalized for bronchiolitis has usually been limited to support care.⁵

In this context, before each winter season, many pediatric departments struggle to define an ideal organization to cope with bronchiolitis epidemics. In the past decade, the number of children hospitalized for bronchiolitis in our institution doubled, from 246 in 2004 to 476 in 2014. Therefore, all the pediatric structures of this tertiary care regional university hospital designed an original organizational infrastructure pediatric plan to best adapt to these growing bronchiolitis epidemics. This plan included a referral flowchart for hospitalized children, an increase in medical and paramedical staff and a restructuring of the pediatric units, with a specific stratification into 4 levels of care.

This study aimed to assess the impact of this organizational infrastructure pediatric plan on the length of stay and quality of care of children hospitalized for bronchiolitis. Moreover, the financial aspects and the staff member's evaluation of the implementation of this plan in the institution were analyzed.

METHODS

Study design and population

This epidemiological retrospective controlled study was carried out in Montpellier University Regional Hospital, France. This institution is the tertiary care pediatric hospital of a region of 1.2 million inhabitants and 12,000 births a year. All children aged less than 2 years hospitalized with a diagnosis of an acute bronchiolitis were eligible for the study. Two groups of patients were defined, depending on the hospitalization period: the group 1 included children admitted prior to the organization plan implementation and the group 2 represented children admitted afterwards. The inclusion period for the group 1 ran from November 2012 to April 2013 and from November 2013 to April 2014 (period 1). The inclusion period for the group 2 ran from November 2015 to April 2016 and from November 2016 to April 2017 (period 2). Patients hospitalized during the transition period (e.g. winter 2014-2015) were not eligible for the study, as the organizational plan was tested for the first time during this period and therefore not fully functional (Figure 1).

Indications to hospitalization were similar during the 2 study periods:

- O₂ saturation (SpO₂) persistently lower than 90-92%, entity of respiratory distress, presence of apnea. In patients with congenital heart disease or bronchopulmonary dysplasia, the need for oxygen therapy was determined relative to habitual transcutaneous saturation measured at the child's baseline status of well-being and not relative to the levels in healthy children (e.g. SpO₂ might be 88% in a Fallot patient).
- Dehydration.

- Moderate to severe bronchiolitis (Table 1).

The hospital discharge database (Programme de Medicalisation des Systemes d'Information, PMSI) was used for patients screening. The PMSI is a mandatory national database linked to the social security, in which all hospitalizations are automatically and prospectively registered. This database uses a standardized diagnosis coding from the 10th revision of the International Classification of Diseases (ICD-10).⁶ Therefore, the following terms and their international codes were selected to identify the patients: acute bronchiolitis (J21), acute bronchitis due to respiratory syncytial virus (J20.5) and respiratory syncytial virus pneumonia (J12.1). Once the patients were identified with their national identification numbers, the institution's department of medical information imported and analyzed all data required for the study.

The organizational infrastructure pediatric plan (OIPP)

The institution is a tertiary care regional university hospital with three departments of medical pediatrics (e.g. general, specialized and intensive care pediatrics) and one department of surgical pediatrics (98 beds, overall). Before the implementation of this plan, children with bronchiolitis referred by the pediatric emergency room (ER) were preferably hospitalized in the general pediatric department, unless requiring intensive care. The lack of beds regularly led to hospitalize these children in the 2 other departments (e.g. specialized and surgical pediatrics) (Figure 1).

In 2014, the medical directors of the 3 pediatric departments, along with the institution administration, drafted a new organizational infrastructure pediatric plan (OIPP), detailed as follows:

- The plan was set up during the winter epidemic, e.g. from November to April. It was first implemented in November 2014.

- A unique flowchart was drafted to frame patients' referral into the different hospitalization units, from the pediatric ER, and designed upon a 4-level of care (Figure 2): patients could be referred to the "epidemic unit" in the general pediatric department (level 1), the neonatal care unit (N-ICU, level 2), the low-intensity medical intensive care (LI-ICU, level 3), or the high intensity medical intensive care unit (HI-ICU, level 4). Bronchiolitis severity was assessed by the usual consensus documents (Table 1).⁷
- The stratification into 4 levels of care required identifying specific hospital areas and beds dedicated to children with bronchiolitis. The level 1 (e.g. the epidemic unit) consisted of non-severe forms of bronchiolitis among children > 1 month old requiring hospitalization in a general pediatric department. The level 2 consisted of 4 beds inside the existing N-ICU, in an isolated area dedicated to neonates with bronchiolitis. The LI-ICU (level 3) consisted of the identification of 4 beds (out of 25) inside the specialized pediatrics department (e.g. in the cardiology and pulmonology unit) for children requiring non-invasive ventilation (NIV). The level 4 represented children with severe conditions related to bronchiolitis and requiring hospitalization in the pediatric intensive care unit (high-intensity intensive care unit, HI-ICU). The levels 1 and 4 were existing units, the level 2 and 3 were specifically created for the OIPP inside existing units, usually dedicated to other types of care.
- The decrease in beds within the specialized pediatrics department was compensated by the identification of 6 beds inside the pediatric surgical department for uninfected children and/or scheduled hospitalizations (Figure 1).

The OIPP required recruiting medical and paramedical staff and reorganizing the permanence of care. A pediatric specialist nurse was positioned at the ER admission to help orientate children, and implement the 4-level of care flowchart. Creating the LI-ICU within the specialized pediatric department required to increase the number of specialist nurses from 1.5 to 3 full-time

equivalents for 10 beds, as required by health authorities. Overall, the OIPP required recruiting 10 full-time equivalent specialist nurses, and 6.5 full-time equivalent pediatric nurse assistants. Moreover, the medical permanence of care was upgraded with an additional intern night shift and a senior on call 24/24 hours (pediatric cardiologists and pulmonologists).

During the OIPP, children with and without bronchiolitis requiring hospitalization were orientated to the different units under the coordination of a nurse administrator, and following specific orientation protocols (Figure 2):

- Children with bronchiolitis: children > 1 month old and > 3.5 kg who did not require NIV were hospitalized in the level 1 unit (e.g. the “epidemic unit”). Neonates < 15 days and < 3.5 kg were hospitalized in the level 2 unit (e.g. the N-ICU). Children requiring NIV or children aged > 15 days were hospitalized in the level 3 unit (e.g. the LI-ICU). Children with severe bronchiolitis were hospitalized in the level-4 unit (e.g. the HI-ICU) based on the following conditions: respiratory failure requiring mechanical ventilation support, apnea with desaturation, and/or severe impairment of general conditions.⁷
- Children with any infectious diseases, apart from bronchiolitis, were hospitalized in the level 1 unit.
- Children with non-infectious diseases were hospitalized either in specialized pediatric unit or in the medical unit delocalized in the pediatric surgery department.

In terms of biomedical material resources, high flow nasal cannula therapy was used as NIV in the level-3 unit and the ER, requiring to acquire 4 AIRVO™ 2 machines (Fisher & Paykel Healthcare, Auckland, New Zealand).

The medical directors of the different pediatric departments drafted harmonized care protocols. All paramedics, residents and fellows working in the units involved in the OIPP followed a 3-

day intensive training program before each epidemic season. At the end of each winter epidemic season, healthcare professionals filled out a questionnaire evaluating the OIPP.

Study outcomes

The primary outcome of this study was the hospital average length of stay. This data is commonly used in healthcare systems to evaluate new hospital organizations because it affects the morbidity, the rate of hospitals occupation (saturation) and the cost of hospitalization.⁸⁻¹¹

In order to evaluate the 4-level of care design, the number of transfers from a unit to another per patient and per hospitalization was analyzed, as well as the distribution of patients hospitalized in each unit. The hospitalization rate in each level of care was defined as the percentage of time spent in each sector. The rate of children readmitted for bronchiolitis within 30 days after hospital discharge was informed, as a quality of care indicator of the OIPP.

The financial aspects of the OIPP implementation were analyzed, given the profound structural modifications for the institution. The financial analysis was performed from the hospital perspective. In term of costs, staff (caregivers' recruitments and payment of guards), and the biomedical equipment were taken into account. In terms of income, we used the DRG tariffs for the hospital stays of each patient included in the study.

In terms of quality of care from healthcare professionals' point of view, the institution senior health executive analyzed the staff questionnaires, anonymously.

Formal aspects

The study was conducted in compliance with the Good Clinical Practices protocol and Declaration of Helsinki principles. After approval by the Local Ethics Committee (2018-IRB-MTP-05-04), and the National Committee on Data Protection (CNIL). The institution received

approval from health authorities to import all hospitalized patients information from the social security database.

Statistical analysis

Patients' characteristics were presented using median and range, or mean and standard deviation (SD) for continuous variables, and frequencies and proportions for categorical variables. Groups (defined by the time period) were compared using Student or Wilcoxon rank test for continuous variables and Chi-square or Fisher test for categorical ones. Statistical bilateral significance threshold was set at 5%. Statistical analyses were performed using SAS version 9.1 (SAS Institute, Cary, North Carolina).

RESULTS

From November 2012 to April 2017, a total of 2042 children under 2 years were hospitalized in the institution with a diagnosis of bronchiolitis. Among them, 406 children were hospitalized during the transition period (winter 2014-2015) and therefore were not analyzed, 718 children were hospitalized during the 2 winter seasons before the OIPP (period 1) and 918 were hospitalized during the two winter seasons after the OIPP implementation (period 2). Therefore, a total of 1636 children were included in the study. Their mean age was 6.1 ± 8.6 months, with a male predominance (55.6 %), and 146 (8.9 %) children born prematurely. There was no significant difference in terms of main population characteristics between children hospitalized in the period 1 and those hospitalized in the period 2 (Table 2).

The hospitalization rate in HI-ICU, was not statistically different between the 2 periods, before and after the OIPP (8% vs. 7%, respectively, $P = 0.06$, respectively) (Table 2).

The mean hospital average length of stay significantly decreased after the OIPP implementation, from 5.1 ± 6.8 days in the period 1 to 3.9 ± 3 days in the period 2 ($P < 0.001$). The

hospitalization rate significantly decreased between period 1 and 2 in the N-ICU and the general pediatric department, by 20% in those 2 units, overall. The hospitalization rate in the LI-ICU (level 3) represented 21% in the period 2.

The number of unit transfers per patient moderately increased after the OIPP implementation, from 1.2 ± 0.7 transfers per hospitalization in the period 1 to 1.3 ± 0.7 in the period 2 ($P < 0.01$). The bed occupancy rate in the LI-ICU (level 3) was 92% (median of 6 beds) (Table 2). The distribution over time of children hospitalized for bronchiolitis within each unit was represented in the Figure 3.

We found no significant difference between the two study periods, concerning the readmission rate within 30 days after hospital discharge: 33 children (4.6%) required hospital readmission during the period 1 versus 31 (3.4%) during period 2 ($P = 0.2$).

The net annual patient service revenue increased from 1 292 532 € to 1 545 720 € between period 1 and 2. This increase mainly came from the LI-ICU tariff supplement reimbursed by the social security (+ 241 050 €). The net annual cumulative profit was 469 207 € after the OIPP implementation.

The overall evaluation of the OIPP by the health care professionals was good (76%) or very good (12%). For 85% of them, the orientation of patients had significantly improved. A large majority judged that the level of care was adapted to the actual patients' severity (88%). For 85% of them, the OIPP reduced the risk of nosocomial infection. The staff members felt that the OIPP saved them time (85%). We observed a much mixed evaluation from the paramedics working in the medical unit relocated in surgery: some of them felt that their training was "correct" (33%) or "middling" (41%) and that patient orientation was "correct" (54%) or "middling" (46%).

DISCUSSION

This epidemiological study from a cohort of 1636 children highlighted the interest of an organizational infrastructure pediatric plan adapted to bronchiolitis epidemics in a tertiary care regional hospital.

Interestingly, despite a constant increase in ER admission for bronchiolitis in the institution, the OIPP implementation resulted in a significant reduction in the hospital average length of stay. Indeed, this original stratification into 4 levels of severity probably participated in the optimization of care. One may hypothesize that in each one of the 4 units, children presented a homogeneous clinical presentation allowing healthcare professionals to use more standardized procedures. Moreover, the OIPP provided a single intensive training plan dedicated to all healthcare professionals working in the different pediatric departments involved in bronchiolitis epidemics. Khan et al. defined health security as a state in which the nation and its people are prepared, protected and resilient to health threats.¹² Experts agree that implementing a standardized system for patient sorting and resource allocation ensures consistent care for all those affected during major epidemics and disasters resulting in a large influx of patients.^{13,14} Thus, the OIPP appears to be in line with such concepts, and therefore seemed to succeed in improving health performance, while maintaining safety.

Epidemics are known to destabilize healthcare structures and stand as a major public health issue. Prior preparation is necessary for hospitals to take care of patients while maintaining an optimal quality of care. In the USA, following the H1N1 pandemic, several studies have tried to determine the tools to put in place to manage future similar crisis situations.^{14,15} Other similar regional institutions similar have set up organizational plans during winter epidemics.¹⁶ For example, the University Hospital in Marseille, France, opened a 10-bed unit in the pediatric

surgery department during the winter epidemic period. This unit implemented standardized care and aimed to limit the risks of nosocomial infections.¹⁷ In Paris, the "bronchiolitis plan" is based on postponements of scheduled hospitalizations, dedicated day hospital beds, doubled ER medical staff and recruitment of interim nurses.¹⁸ However, to our knowledge, the impact and effectiveness of such plans have been scarcely evaluated or reported.

When designing the OIPP stratification into 4 levels of care, we feared that it might increase the number of transfers from a unit to another, resulting in more workload for the nursing staff. Fortunately, this increase remained low and acceptable, with an average 1.3 transfers per patient and per hospitalization (vs. 1.2 before the OIPP) and the nurses' questionnaires related an overall improved organization. Moreover, the absence of increase in readmission rates after hospital discharge confirmed that, despite shorter hospitalizations, the quality of care remained optimal and patients were not discharged too early after the OIPP implementation. Indeed, the readmission rate for bronchiolitis in this study was 4.6% before the OIPP and 3.4% afterwards, which is quite similar to that found in the literature. In their study, Nakamura et al. reported an average readmission rate of 5.5% in children less than 18 years old hospitalized for respiratory infection.¹⁹

The use of high-flow nasal cannula in a conventional hospitalization pediatric unit (level 3) might have participated in the decrease of the length of stay. Similarly, Riese and al. reported that the use of high-flow nasal cannula outside intensive care services reduced the length of hospital stay.⁹ It is important to note that, in our study, the rate of patients hospitalized in the pediatric high-intensity intensive care unit (level 4) was similar before and after the OIPP, therefore the most severe forms of bronchiolitis remained stable. Indeed, patients hospitalized in the low-intensive care unit (level 3) during the OIPP were most probably patients previously hospitalized in the general pediatric department (level 1) before the OIPP.

In a difficult economic context, the OIPP implementation should not place the institution in financial deficit, in order to be perpetuated. Therefore, the hospital administration obtained approval from the health authorities to tariff the low intensity intensive care unit as a regular pediatric intensive care unit. As a result, after payment of staff and material charges, the OIPP was financially beneficial. After 3 winter epidemic seasons, and a maintained balanced budget, the OIPP recently went out of the test period and was implemented in the long term by the hospital administration.

The evaluation by all healthcare professionals concerned by the OIPP was quite encouraging. They much appreciated the recruitment of temporary staff, the harmonized training program, and the homogenization of patients in each dedicated area by level of severity. However, we observed a much-mixed evaluation from paramedics in the medical unit delocalized in surgery. Indeed, these staff members, trained in pediatric surgery, had to adapt to a high number of medical pathologies usually treated in pediatric sub-specialties (inflammatory diseases, diabetes, arrhythmia, etc.).

Other types of healthcare organizations have been reported, such as home-based care for the least severe patients. Indeed, Sandweiss et al. have demonstrated that the use of a protocol including the use of oxygen in the patient's home reduced the length of hospital stay.¹¹ The association of such home-based care with the OIPP would probably be of interest. It will be tested in our institution for the coming winter season, and we will add an evaluation on health-related quality of life.

Study limitations

In this single center retrospective study, the comparison of the OIPP to an “historic” cohort presented some limitations. Despite access to exhaustive sources from the discharge database, we were unable to study detailed medical data such as virology and population characteristics (exposure to passive smoking, underlying pathology, clinical severity score of bronchiolitis, etc.). For instance, we did not study the impact of the OIPP on the nosocomial infections. In addition, this study spanned a period of 5 years, during which practices might have evolved. However, the last French guidelines (2000) and the more recent recommendations of the American Academy of Pediatrics did not bring many differences in care.²⁰

CONCLUSION

The implementation of an organizational infrastructure pediatric plan adapted to bronchiolitis epidemics in a regional tertiary care pediatric hospital resulted in a significant decrease in the average hospital length of stay. Using a standardized algorithm of patient orientation and a 4-level stratification of care, this plan improved the quality of care, while maintained a balanced budget for the institution. The evaluation of the plan by caregivers suggested an improvement of their working conditions. This plan was the result of intense collaborative work between healthcare staff members and hospital managers, and after a 3-year period of test, it was implemented in the long term by the hospital administration.

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Conflicts of interest: none.

REFERENCES

1. Smyth RL, Openshaw PJM. Bronchiolitis. *Lancet* (London, England). 2006;368(9532):312–322. doi:10.1016/S0140-6736(06)69077-6
2. Hall CB, Weinberg GA, Iwane MK, Blumkin AK, Edwards KM, Staat MA, Auinger P, Griffin MR, Poehling KA, Erdman D, et al. The burden of respiratory syncytial virus infection in young children. *The New England Journal of Medicine*. 2009;360(6):588–598. doi:10.1056/NEJMoa0804877
3. Grimprel E. Épidémiologie de la bronchiolite du nourrisson en France. *Archives de Pédiatrie*. 2001;8:83–92. doi:10.1016/S0929-693X(01)80162-7
4. Bulletin épidémiologique bronchiolite. Bilan de la surveillance 2016-2017. / Archives / Situation épidémiologique de la bronchiolite en France métropolitaine / Bronchiolite / Infections respiratoires / Maladies infectieuses / Dossiers thématiques / Accueil. [accessed 2018 Jul 2]. <http://invs.santepubliquefrance.fr/Dossiers-thematiques/Maladies-infectieuses/Infections-respiratoires/Bronchiolite/Situation-epidemiologique-de-la-bronchiolite-en-France-metropolitaine/Archives/Bulletin-epidemiologique-bronchiolite.-Bilan-de-la-surveillance-2016-2017>
5. Ralston SL, Lieberthal AS, Meissner HC, Alverson BK, Baley JE, Gadomski AM, Johnson DW, Light MJ, Maraga NF, Mendonca EA, et al. Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis. *Pediatrics*. 2014 Oct 27:peds.2014-2742. doi:10.1542/peds.2014-2742
6. Beckman KD. Coding Common Respiratory Problems in ICD-10. *Family Practice Management*. 2014;21(6):17–22.

7. Baraldi E, Lanari M, Manzoni P, Rossi GA, Vandini S, Rimini A, Romagnoli C, Colonna P, Biondi A, Biban P, et al. Inter-society consensus document on treatment and prevention of bronchiolitis in newborns and infants. *Italian Journal of Pediatrics*. 2014;40:65. doi:10.1186/1824-7288-40-65
8. Franklin D, Babl FE, Schlapbach LJ, Oakley E, Craig S, Neutze J, Furyk J, Fraser JF, Jones M, Whitty JA, et al. A Randomized Trial of High-Flow Oxygen Therapy in Infants with Bronchiolitis. *The New England Journal of Medicine*. 2018;378(12):1121–1131. doi:10.1056/NEJMoa1714855
9. Riese J, Fierce J, Riese A, Alverson BK. Effect of a Hospital-wide High-Flow Nasal Cannula Protocol on Clinical Outcomes and Resource Utilization of Bronchiolitis Patients Admitted to the PICU. *Hospital Pediatrics*. 2015;5(12):613–618. doi:10.1542/hpeds.2014-0220
10. Mahant S, Wahi G, Giglia L, Pound C, Kanani R, Bayliss A, Roy M, Sakran M, Kozlowski N, Breen-Reid K, et al. Intermittent versus continuous oxygen saturation monitoring for infants hospitalised with bronchiolitis: study protocol for a pragmatic randomised controlled trial. *BMJ open*. 2018;8(4):e022707. doi:10.1136/bmjopen-2018-022707
11. Sandweiss DR, Mundorff MB, Hill T, Wolfe D, Greene T, Andrews S, Glasgow TS. Decreasing hospital length of stay for bronchiolitis by using an observation unit and home oxygen therapy. *JAMA pediatrics*. 2013;167(5):422–428. doi:10.1001/jamapediatrics.2013.1435
12. Khan AS, Lurie N. Health security in 2014: building on preparedness knowledge for emerging health threats. *Lancet (London, England)*. 2014;384(9937):93–97. doi:10.1016/S0140-6736(14)60260-9
13. Christian MD, Devereaux AV, Dichter JR, Rubinson L, Kissoon N, Task Force for Mass Critical Care, Task Force for Mass Critical Care. Introduction and executive summary: care of

the critically ill and injured during pandemics and disasters: CHEST consensus statement. *Chest*. 2014;146(4 Suppl):8S-34S. doi:10.1378/chest.14-0732

14. Beigi R, Davis G, Hodges J, Akers A. Preparedness planning for pandemic influenza among large US maternity hospitals. *Emerging Health Threats Journal*. 2009;2:e2. doi:10.3134/ehth.09.002

15. Filice CE, Vaca FE, Curry L, Platis S, Lurie N, Bogucki S. Pandemic planning and response in academic pediatric emergency departments during the 2009 H1N1 influenza pandemic. *Academic Emergency Medicine: Official Journal of the Society for Academic Emergency Medicine*. 2013;20(1):54–62. doi:10.1111/acem.12061

16. Mercier J-C, Bellettre X, Lejay É, Desmarest M, Titomanlio L. [Paediatric emergencies; example of the management of winter epidemics]. *La Revue Du Praticien*. 2015;65(1):47–50.

17. Interview du Dr Patrick Guérin - Génération juin 66 - Canicule, grippe, bronchiolite... Des maillons forts de la veille sanitaire - Vidéo. [accessed 2018 Jun 25]. https://www.lequotidiendumedecin.fr/actualites/video/partenaires/generation-juin-66/2015/09/17/generation-juin-66-canicule-grippe-bronchiolite-des-maillons-forts-de-la-veille-sanitaire_839491

18. Bégué P, Grimprel E. Epidémiologie de la bronchiolite à VRS: Conséquences sur l'organisation des soins: Bronchiolites aiguës. *Médecine & enfance*. 1996;16(12):491–492.

19. Nakamura MM, Zaslavsky AM, Toomey SL, Petty CR, Bryant MC, Geanacopoulos AT, Jha AK, Schuster MA. Pediatric Readmissions After Hospitalizations for Lower Respiratory Infections. *Pediatrics*. 2017;140(2). doi:10.1542/peds.2016-0938

20. American Academy of Pediatrics Subcommittee on Diagnosis and Management of Bronchiolitis. Diagnosis and management of bronchiolitis. *Pediatrics*. 2006;118(4):1774–1793. doi:10.1542/peds.2006-2223

TABLES AND FIGURES

Table 1: Assessment of bronchiolitis severity.

	Mild	Moderate	Severe
Respiratory rate	Normal to slightly increased	Increased	Markedly increased compared to normal values
Respiratory effort	Mild chest wall retraction	Tracheal tug Nasal flare Moderate chest wall retraction	Marked chest wall retraction Nasal flare Grunting
Oxygen saturations	No supplemental oxygen requirement, O ₂ saturations > 95%	Saturations 90-95%	Saturations < 90%, may not be corrected by O ₂
Feeding	Normal to slightly decreased	50-75% of normal feeds	< 50% of feeds, unable to feed
Apnea	Nil	May have brief episodes	May have increasing episodes

Table 2. Comparison of outcomes between period 1 (before OIPP) and period 2 (OIPP).

Outcomes	N	Period 1	N	Period 2	P-value
		Before OIPP		OIPP	
Gender (male)	718	418 (58.2)	918	491 (54.8)	0.06
Age (months)	718	5.7 ± 7.8	918	6.5 ± 9.3	0.08
Preterm (N)	718	65 (9.1)	918	81 (8.8)	0.9
Average length of stay (days)	718	5.1 ± 6.8	918	3.9 ± 3	<0.001
General pediatric department hospitalization rate (%)	718	82 ± 34	918	68 ± 43	<0.001
N-ICU hospitalization rate (%)	718	8 ± 25	918	2 ± 15	<0.001
LI-ICU hospitalization rate (%)	718	0 ± 0	918	21 ± 37	<0.001
HI-ICU hospitalization rate (%)	718	8 ± 23	918	7 ± 22	0.2
Number of unit transfers per hospitalization (N)	718	1.2 ± 0.7	918	1.3 ± 0.7	<0.001
Readmission < 30 days after discharge (N)	718	33 (4.6)	918	31 (3.4)	0.2

Legend: OIPP, organizational infrastructure pediatric plan; N-ICU, neonatal intensive care unit; LI-ICU, low intensity intensive care unit; HI-ICU, high intensity intensive care unit. Values are mean ± SD or N (%). Significant P-values are marked in bold.

Figures legends

Figure 1. Organization diagram before and after the OIPP

This graph represents hospital areas and beds dedicated to children with bronchiolitis in the institution before (period 1) and after (period 2) the OIPP implementation.

Legends: HI-ICU: high-intensity medical intensive care unit; LI-ICU: low-intensity medical intensive care unit; N-ICU: neonatal medical intensive care unit; OIPP: organizational infrastructure pediatric plan.

Figure 2. The OIPP stratification into 4 levels of care

This graph represents the orientation protocol used from the pediatric ER to refer patients to the different hospitalization units, following a 4-level of care.

Legend: HI-ICU: high-intensity medical intensive care unit; LI-ICU: low-intensity medical intensive care unit; N-ICU: neonatal medical intensive care unit; NIV: non-invasive ventilation; OIPP: organizational infrastructure pediatric plan.

Figure 3. Evolution of the distribution of hospitalization length for bronchiolitis within each unit over time

This graph represents the distribution (in %) of length of stay for bronchiolitis within each unit before (period 1) and after (period 2) the OIPP implementation.

Legend: ICU: intensive care unit.

Legends: HI-ICU: high-intensity medical intensive care unit; LI-ICU: low-intensity medical intensive care unit; N-ICU: neonatal medical intensive care unit; OIPP: organizational infrastructure pediatric plan.

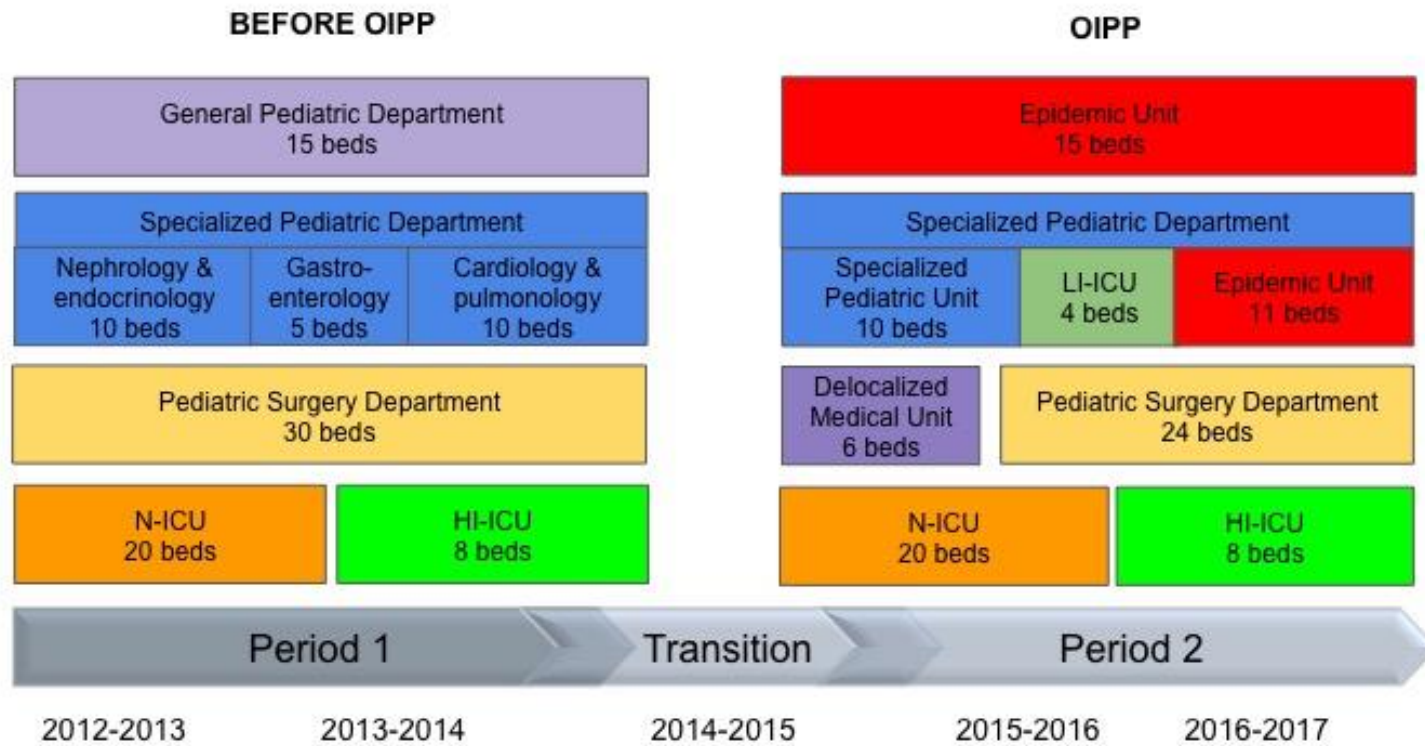


Figure 1. Organization diagram before and after the OIPP

Legend: HI-ICU: high-intensity medical intensive care unit; LI-ICU: low-intensity medical intensive care unit; N-ICU: neonatal medical intensive care unit; NIV: non-invasive ventilation; OIPP: organizational infrastructure pediatric plan.

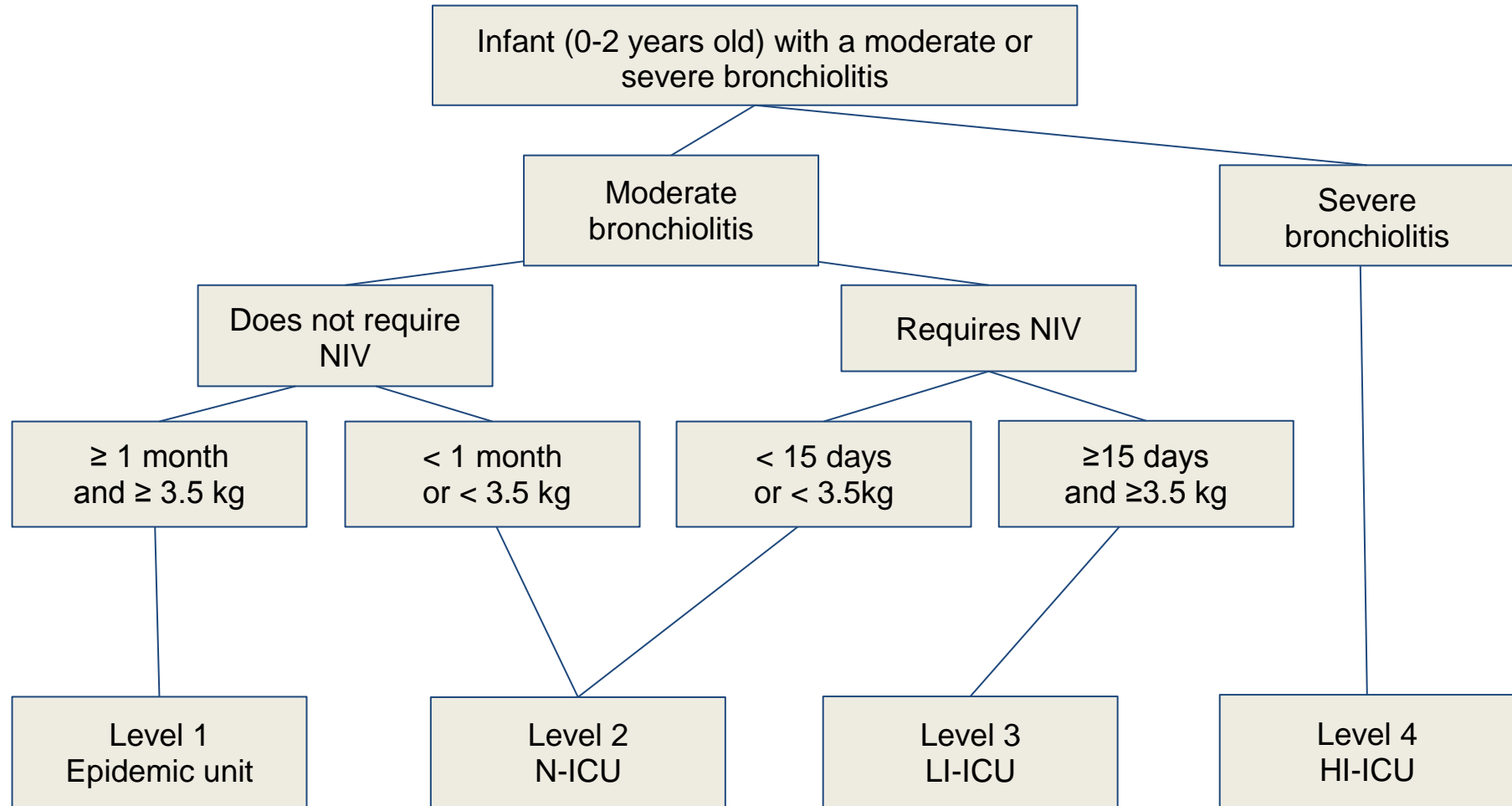


Figure 2. The OIPP stratification into 4 levels of care

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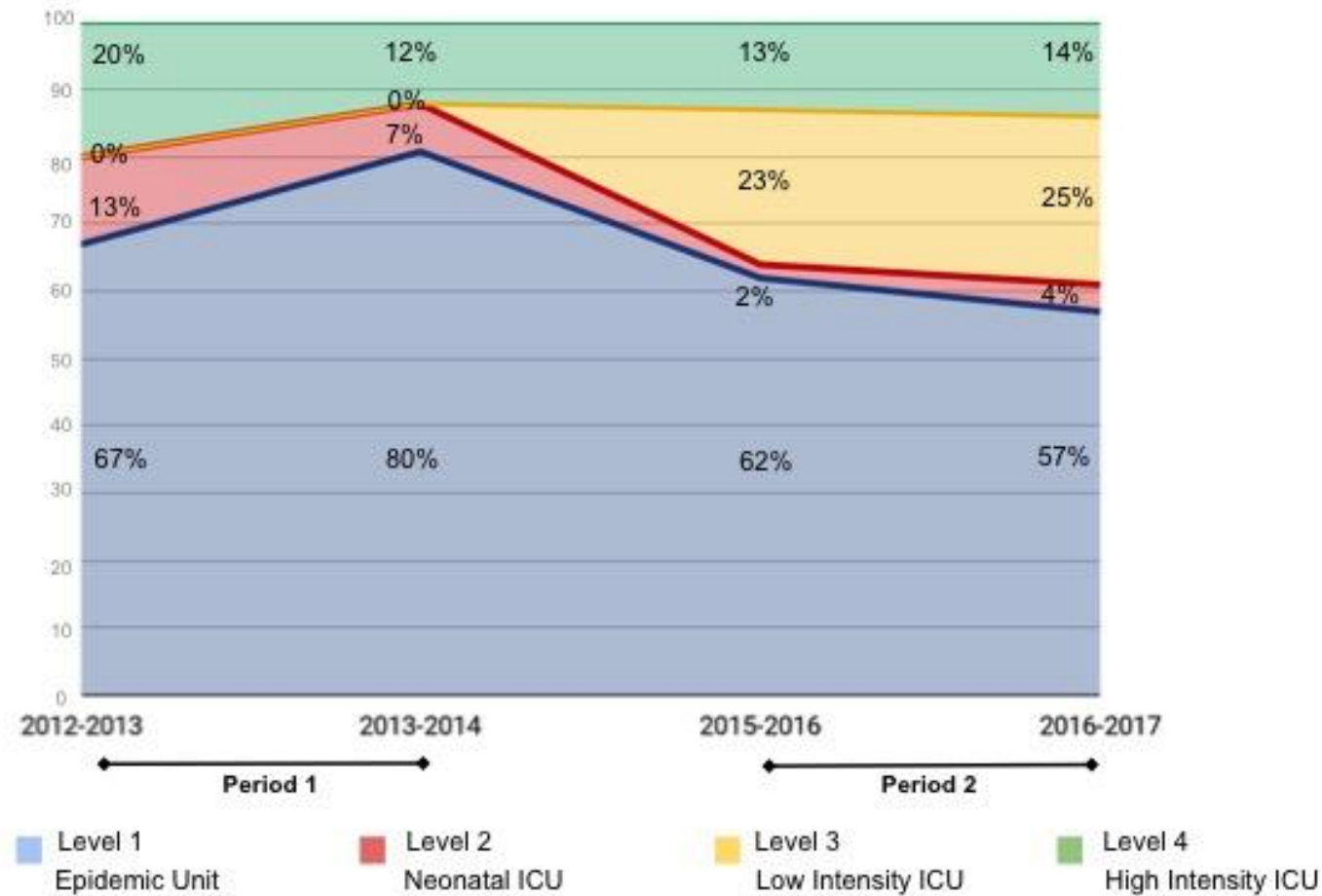


Figure 3. Evolution of the distribution of hospitalization length for bronchiolitis within each unit over time

ANNEXE: Avis de l'Institutional Review Board



Institutional Review Board (I.R.B.) C.H.U. de Montpellier

Président :
Professeur Olivier JONQUET

Secrétariat IRB
Tél : 04.67.33.98.33 / 04.67.33.08.12
Fax : 04.67.33.91.72

Les recherches organisées et pratiquées sur l'être humain en vue du développement des connaissances biologiques ou médicales dites, "recherches impliquant la personne humaine" telles que définies dans l'Article L. 1121-1 du Code de Santé Publique relèvent d'un Comité de Protection des Personnes (CPP) et ne peuvent pas faire l'objet d'un examen par l'IRB.

Titre complet du projet : « Evaluation du plan épidémie en pédiatrie »

Date de la réunion : R9 (23/05/2018)

Membres présents :

Olivier JONQUET
Boris JUNG
Ingrid MILLET
Laurent LEMAITRE
Fabrizio PANARO
Pascal AMEDRO
Anne VERCHERE
Nicolas MOLINARI
Emilie OLIE
Odile BARDET

Porteur de projet : LAVILLEDIEU David

Etablissement de rattachement : CHU de Montpellier

Service de rattachement : Pédiatrie

Equipe méthodologique impliquée : Oui Non

Avis de l'IRB Favorable Défavorable
 A soumettre à un CPP Différé
 Non compétent

Documents portés à la connaissance du CLER/IRB pour l'examen :

- Synopsis : V2 du 02/05/2018
- Note d'information : V2 du 02/05/2018
- Commentaires :

Avis favorable CLER

Numéro attribué par l'IRB : 2018_IRB-MTP_05-04

Date : 15/06/2018

Signature

CENTRE HOSPITALIER DE MONTPELLIER
191, Avenue du Doyen Gaston GIRAUD
34 295 MONTPELLIER CEDEX 5

Le présent avis ne dégage par le porteur de projet des obligations au regard de la Loi Informatique et Libertés.

ABSTRACT

Background: Acute bronchiolitis epidemics are known to destabilize healthcare structures and stand as a major public health issue. Our tertiary care regional university hospital designed an organizational infrastructure pediatric plan (OIPP) to adapt to bronchiolitis epidemics. This study aimed to assess the impact of the OIPP on the length of stay and quality of care of children hospitalized for bronchiolitis.

Methods: This epidemiological study analyzed data from 2 epidemic seasons before and after the OIPP implementation. The OIPP used a standardized algorithm of patient orientation and a 4-level stratification of care.

Results: A total of 1636 children were included in the study, with 718 children before and 918 children after the OIPP implementation. Patients' characteristics were similar between the 2 periods. The length of stay significantly decreased after the OIPP implementation, from 5.1 ± 6.8 days to 3.9 ± 3 days ($P < 0.001$). The number of unit transfers per patient and per hospitalization moderately increased from 1.2 ± 0.7 to 1.3 ± 0.7 ($P < 0.01$). The 30-day readmission for bronchiolitis remained stable (4.6% vs. 3.4%, $P = 0.2$). The net annual patient service revenue increased from 1 292 532 € to 1 545 720 €.

Conclusion: The implementation of the OIPP resulted in a significant decrease in the average hospital length of stay. Using a standardized algorithm of patient orientation and a 4-level stratification of care, this plan improved patients' quality of care while maintained a balanced budget.

SERMENT

- *En présence des Maîtres de cette école, de mes chers condisciples et devant l'effigie d'Hippocrate, je promets et je jure, au nom de l'Être suprême, d'être fidèle aux lois de l'honneur et de la probité dans l'exercice de la médecine.*
- *Je donnerai mes soins gratuits à l'indigent et n'exigerai jamais un salaire au-dessus de mon travail.*
- *Admis (e) dans l'intérieur des maisons, mes yeux ne verront pas ce qui s'y passe, ma langue taira les secrets qui me seront confiés, et mon état ne servira pas à corrompre les mœurs, ni à favoriser le crime.*
- *Respectueux (se) et reconnaissant (e) envers mes Maîtres, je rendrai à leurs enfants l'instruction que j'ai reçue de leurs pères.*
- *Que les hommes m'accordent leur estime si je suis fidèle à mes promesses. Que je sois couvert (e) d'opprobre et méprisé (e) de mes confrères si j'y manque.*

RESUME

Introduction: Les épidémies de bronchiolite aiguë sont connues pour déstabiliser les structures de soins et constituent un enjeu majeur de santé publique. Notre hôpital universitaire régional de soins tertiaires a conçu un plan organisationnel épidémique (POE) pour s'adapter aux épidémies de bronchiolite. Cette étude visait à évaluer l'impact du POE sur la durée du séjour et la qualité des soins des enfants hospitalisés pour une bronchiolite.

Méthode: Cette étude épidémiologique a analysé les données de deux saisons épidémiques avant et après la mise en œuvre du POE. Le POE a utilisé un algorithme normalisé d'orientation des patients et une stratification des soins à quatre niveaux

Résultats: Au total, 1636 enfants ont été inclus dans l'étude, avec 718 enfants avant et 918 enfants après la mise en œuvre du POE. Les caractéristiques des patients étaient semblables entre les deux périodes. La durée d'hospitalisation a diminué de façon significative après la mise en œuvre du POE, passant de $5,1 \pm 6,8$ jours à $3,9 \pm 3$ jours ($P < 0,001$). Le nombre de transferts unitaires par patient et par hospitalisation a augmenté modérément, passant de $1,2 \pm 0,7$ à $1,3 \pm 0,7$ ($P < 0,01$). Les réhospitalisations à 30 jours pour bronchiolite sont demeurées stables (4,6 % vs 3,4 %, $P = 0,2$). Les recettes des services lors des saisons épidémiques sont passées de 1 292 532 € à 1 545 720 €.

Conclusion: La mise en œuvre du POE a entraîné une diminution importante de la durée d'hospitalisation. En utilisant un algorithme normalisé d'orientation des patients et une stratification des soins à quatre niveaux, ce plan a amélioré la qualité des soins des patients tout en maintenant un budget équilibré.