Time Driven Activity Based Costing (TDABC), cost calculation model adapted to chronic disease care pathway? Cases of stroke care pathway

Le Time Driven Activity Based Costing (TDABC), modèle de calcul de coût adapté au parcours de soins des maladies chroniques ? Cas du parcours de soins de l'accident vasculaire cérébral (AVC)

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ABSTRACT

Chronic diseases are the main item of health expenditure, they require a global and transversal support of the patient via the care pathway, while Diagnosis related groups based payment contributes to strengthening the divisions. An intervention research on a chronic disease pathway, the stroke, 3rd death cause in France, aims verifying the applicability of a cost-per-activity calculation such as Time Driven Activity Based Costing (TDABC). According to the criteria of simplicity and precision of cost evaluation methods, the literature suggests that a cost-peractivity calculation is adapted to the transversal approaches and to the health sector. The research findings limited to a part of the pathway show the applicability of TDABC and the taking into account in the time equations of the cost variations linked to the pathways diversity and the treatment evolutions. Despite the method limitations (difficulty of estimating time and considering what is non-quantifiable as the cares value), the TDABC presents several contributions : possible simplification by the Pareto law, a tool that is understandable by heath professionals and sparking dialogue, simulation of the "hidden costs" of resource unavailability and bottlenecks.

Key-words

TDABC, Cost calculation, Hidden costs, Chronic disease, Healthcare pathway

RÉSUMÉ

Premier poste des dépenses de santé, les maladies chroniques nécessitent une prise en charge globale et transversale du patient via le parcours de soins, alors que la tarification à l'activité contribue à renforcer les cloisonnements. Une recherche intervention sur le parcours d'une maladie chronique, l'Accident Vasculaire Cérébral (AVC), 3e cause de décès en France, a pour objectif de vérifier l'applicabilité d'un calcul de coût par activité comme le Time Driven Activity Based Costing (TDABC). Selon les critères de simplicité et précision des méthodes d'évaluation de coûts, la littérature suggère que le TDABC est

adapté aux approches transversales et au secteur de la santé. Les résultats de la recherche restreinte à une partie du parcours, montrent l'applicabilité du TDABC et la prise en compte dans les équations de temps des variations de coûts liées à la diversité des parcours et aux évolutions des traitements. Malgré les limites de la méthode pour l'estimation du temps et du non chiffrable comme la valeur des soins, le TDABC présente plusieurs apports : simplification possible par la loi de Pareto, outil compréhensible par les professionnels de santé et suscitant le dialogue, simulation des « coûts cachés » de l'indisponibilité des ressources et des goulots d'étranglement.

Mots-clés

TDABC, calcul de coûts, coûts cachés, maladies chroniques, parcours de soins

INTRODUCTION

Activity-based tariffs have fallen short of their target to reduce healthcare expenditure. This method has even caused a few irregularities, such as overcoding and unnecessary medical acts in an attempt to maximise reimbursements (Angelé-Halgand 2015; Angelé-Halgand & Garrot 2014; Georgescu & Hartmann 2013; Georgescu & Naro 2012; Or & Renaud 2009). Activity-based tariffs rely on a mechanism underpinned by the National Scale Costs with Common methodology (ENCC). ENCC is driven by a full cost system based on the method of the identification of homogeneous sections (Angelé-Halgand & Garrot 2014; Moisdon 2015; Moisdon & Pépin 2010). However, this method has been strongly criticised for being unable to effectively allocate all charges, which has led to calls for the development of the Activity Based Costing method. The literature also emphasises the poorer degree of accuracy of cost calculations obtained (De La Villarmois & Levant 2010; Moisdon 2015). Activity-based tariffs neither reflect nor cover the real consumption of resources (Angelé-Halgand & Garrot 2014). A number of authors argue that these tariffs are ill adapted to a changing health system (Angelé-Halgand & Garrot 2014; Kaplan & Porter 2011; Kaplan & Witkowski 2014). Others have highlighted the lack of usefulness of the tools that have emerged (Colasse 2011). Indeed, faced with an ageing population, chronic diseases are a major health issue and account for the bulk of healthcare costs (Baszanger 1986). They require the comprehensive care of patients through the management of their care pathways (Brunn & Chevreul 2013; Levesque *et al.* 2009).

Various actions and experiments have been initiated to promote bundled payments across a full cycle of care (Angelé-Halgand 2014; Porter & Kaplan 2016). The cycle of care is defined as "*a chain of episodes of care*" (Angelé-Halgand & Garrot 2014). In the United States, these initiatives have been grouped under the title *Bundled Payments for Care Improvement (BPCI) Initiative*[1]. In France, however, Regional Public Health Authorities (*Agence Régionale de santé* - ARS) commonly use the term 'healthcare pathways'. The French social security financing bill (PLFSS 2013) also provides for experiments and proposes specific funding for the healthcare pathways of patients sufferings from chronic renal failure and breast and prostrate cancer treated by external radiation. Pathways make it possible to "*better coordinate*" (Angelé-Halgand 2014) and decompartmentalise the hospital system by promoting cooperation between different health care providers around a given pathology. On its information portal, the ARS summarises the approach in terms of pathways as follows: "Ensure that the right people receive the right care from the right health professionals in the right organisation at the right time, all at the right cost."[2].

1 [https://innovation.cms.gov/initiatives/bundled-payments/]

2 [http://www.ars.sante.fr/Parcours-de-soins-parcours-de.148927.0.html]

The recent launch of hospital groups of territories (*groupements hospitaliers de territoires* - GHT) appears to share these views. According to the ARS, GHT are expected to "*ensure all patients have better access to care by strengthening the cooperation between public hospitals around a medical project*"[3] across a region. Might this reflect a step forward preparing health care professionals to migrate to a system that favours the financing of care pathways?

We will focus on the healthcare pathway which refers to all occasions on which an ordinary patient turns to local medical care, either in short-stay facilities (Medical, Surgical, and Obstetrical ward units - MCO), medium-stay medico-social structures (rehabilitative care - SSR) and long-stay hospital facilities (long-term care - USLD, and nursing homes - EHPAD). Healthcare pathways induce the concept of transversality. However, as mentioned earlier, the current cost calculation system used in hospitals appears unsuitable for this approach because it is excessively compartmentalised (Colasse 2011; Kaplan & Porter 2011). All these changes, which tend to more firmly anchor the concept of pathways to the healthcare scene, raise the following question: is a cost-per-activity calculation approach such as Time Driven Activity Based Costing (TDABC) the most appropriate approach for a chronic disease care pathway?

This paper consists of four sections. The first presents the changes that have occurred in the health sector and the limits of activity based tariffs. The second sets out the theoretical framework of TDABC. The third presents the field of study and the methodology. The last section presents the results and discusses the study's limitations as well as future perspectives.

1. CHRONIC DISEASES: from activity based tariffs to healthcare pathways

The rapid development of chronic disease calls for an approach in terms of healthcare pathway (1.1), an approach incompatible with activity-based tariffs (1.2).

1.1. The emergence of the concept of chronic disease healthcare pathways

1.1.1. The preponderance of long-term (chronic) illnesses

One of the major concerns in health widely reported by the media regards chronic diseases. According to the World Health Organization (WHO), these diseases are a major public health issue (Baszanger 1986; Brunn & Chevreul 2013; Levesque *et al.* 2009). The WHO defines chronic disease as "*of long duration and generally slow progression, which are by far the leading causes of death in the world, representing 63% of all annual deaths (heart disease, strokes, cancer, chronic obstructed pulmonary disease, diabetes.)*"

In France, article l. 322-3 of the Social Security Code defines long-term illness as "*illnesses which require lengthy treatment and particularly expensive therapy*." In 2006, one study had already highlighted that between 1994 and 2004, there had been a sharp increase in the cost of long-term illnesses. Some 64% of the total expenditures of health insurance involved these illnesses, which explains the 90% rise in annual expenditure.

Chronic diseases require comprehensive care because they depend upon both healthcare professionals and other professionals outside the health sector. Both the discourses of healthcare stakeholders as well as existing action plans appear to point in this direction. The concept of integrated care thus refers to the actions implemented for the comprehensive care of chronic disease (Brunn & Chevreul 2013; Levesque *et al.* 2009). This model takes into account all the different stakeholders involved in a

3 [http://www.ars.sante.fr/GHT-groupements-hospitaliers.190673.0.html]

patient's healthcare pathway. It is based on multiple concepts in order to contribute to the effectiveness and efficiency of the care given those suffering from chronic disease.

In France, some of the changes observed have drawn their inspiration from practices undertaken in the United States for chronic disease management. Levesque *et al.* (2009) specify that the French Hospital, Patients, Health and Regions Act (HPST) displays genuine advantages which enable the better management of chronic diseases. In France, however, these cross-cutting approaches to healthcare have encountered the limits of the current activity-based tariffs, which encourage competition rather than cooperation between the different stakeholders. Studies to address the inadequacies of activity-based tariffs have been implemented, some of which have been referred to as 'experimenting with new methods of payment'. Law No. 2013-1203, of December 23, 2013, appertaining to the social security financing for 2014, provided for two studies on the care of chronic renal failure and radiation therapy to treat cancer. These experiments were clearly aimed at optimising the healthcare pathway to promote better care quality and optimise health insurance costs.

A small number of researchers in management sciences argue that hospital reforms have undesirable consequences. According to Kaplan and Porter (2011), the current health management systems (notably activity-based tariffs) are unable to effectively curb rising costs and may even generate, among other things, cross-subsidies that penalise efficient structures. They point out that in management that which cannot be measured can neither be easily managed nor improved. As a result, the authors have explored new avenues of reflection, notably an approach centred on the patient and his or her pathologies, the creation of value for the patient at minimal total cost (Kaplan & Porter, 2011), and the all-round care of certain diseases (pathologies), notably chronic diseases. Several healthcare professionals as well as regulators and researchers have also called for the need to go beyond an approach that focuses on the length of patients' stay in order to take into account the global nature of the patient's pathway.

1.1.2. The emergence of the notion of healthcare pathway

In its 2012 annual report, the High Council for the Future of Health Insurance (HCAAM) suggested that there was a need to "*shift away from the view of the practice of medicine as a succession of one-off and independent acts to what may be referred to as a healthcare 'pathway'. In other words, a practice of medicine – broadly understood as more than the actions undertaken by doctors alone – whose objective is to promote more collaborative practice between professionals and a more active participation of patients in order to achieve overall healthcare quality over the long-term.*"

The concept of a healthcare pathway is prevalent in the current discourse on health. It primarily seeks to provide patients with better care through the creation of value for them and a better management of the expenses associated with the care they receive (Kaplan & Porter 2011). The concept of a chronic disease healthcare pathway is now increasingly common. The web portal of the Regional Public Health Authorities (ARS) makes it clear that the health system is in need of change because of the spread of these diseases. Indeed, recent health expenditure studies have shown that curative (acute) care is less significant than chronic disease care.

The ARS defines the concept of healthcare pathway as: "T*he overall trajectory of patients and users on the territory where their healthcare is provided, with special attention paid to individuals and to their choices. It requires the coordinated action of professionals from the prevention, health, medico-social and social sectors. It incorporates the key factors in health, i.e., hygiene, lifestyle, education, the workplace and the environment. While each individual has a unique pathway, at the community level it is possible to identify and organise typologies of pathways a priori and to calibrate and anticipate the necessary resources.*"

The ARS has identified three concepts of pathways, namely healthcare pathway, health pathway and life pathway. The healthcare pathway involves primary health care, avoidable hospitalisation (emergencies), home-based care, rehabilitative care, long-term care (USLD), and nursing homes (EHPAD).

The health pathway is a healthcare pathway that connects upstream, primary and social prevention, and downstream, medical and social support and maintenance or return to the home environment. The life pathway is an individual's specific trajectory: schooling, the prevention of professional exclusion, rehabilitation, and housing.

Put differently, the healthcare pathway may refer to all the occasions on which care is proposed to an ordinary patient in local medical care, short-stay facilities (Medical, Surgical, and obstetrical ward units, or MCO) medium-stay medico-social structures (rehabilitative care) and long-stay hospital facilities (long-term care – USLD – and nursing homes, or EHPAD). The health pathway covers the scope of healthcare pathway and integrates the prevention aspect. The life pathway includes the health pathway and extends to other dimensions indirectly related to an individual's health such as his or her professional situation. The French National Authority for Health (Haute Autorité de Santé - HAS) stresses the importance of pathways, notably healthcare pathways which allow "to *reconcile in the best way possible, the quality of care practices and the efficiency of the healthcare system*."[4] HAS has written a number of pathway guides and the ARS has compiled a glossary of pathway terminology.

1.2. Activity-based tariffs: an ill-adapted system?

1.2.1. Activity-based tariffs and their limits

Activity-based tariffs are a healthcare financing system that associates payment to the activity performed, as defined by the episodes of care. According to Or and Renaud (2009), these tariffs are based on two fundamental factors, namely: the description of hospital activity through homogeneous groups of patients (*groupes homogènes de malades* - GHM) and the prior definition of GHM tariffs (prospective payments). In France, these prices are set at the national level. Or and Renaud state that the implementation of these fundamental factors differs across countries. According to them, activity based tariffs have three advantages: transparency, fairness and efficiency. Indeed, financing hospital healthcare based on production helps improve transparency and equity among institutions compared to the relatively opaque global staffing system previously used. In addition, activity-based tariffs establish some form of competition between institutions, thereby - provided that tariffs actually correspond to the costs of the most efficient institutions - improving efficiency. However, as a financing mechanism, activity-based tariffs induce effects that do not necessarily coincide with the political objectives assigned by the authorities of the countries which have adopted this payment system. Or and Renaud (2009) have identified two negative effects associated with T2A: the quality of care and control over expenditure.

The effects associated with the quality of care

The application of activity-based tariffs in many countries, including the United States, has reduced patients' hospital length of stay. Indeed, while the content of the service associated with payment is ill-defined (the care provided in a GHM stay), the health provider tends to reduce the services provided in the package proposed and to transfer the responsibility (and cost) to others, i.e., cost shifting. Put differently, institutions seek to reduce the costs of their hospital stays by limiting patients' length of stay and by directing them to other institutions, such as rehabilitative care, outpatient care and home-based care. Citing Newhouse, Or and Renaud point out that the shorter hospital length of stay in the United States has been followed by a sharp increase in rehabilitative and home-based care. There is thus a need to create a coherent funding system between different modes of care for the same episode of care to avoid this 'communicating vessel' phenomenon (Cash *et al.* 2003, cited by Or and Renaud 2009). Activity-based tariffs have also led some institutions to deliberately avoid specialising in costly diseases or to outsource some services. This phenomenon is also reflected in selection

4 Newsletter of the French National Authority for Health • n° 36: [http://www.has-sante.fr/portail/jcms/c_1616095/fr/des-parcours-de-soins-pour-un-systeme-de-sante-plus-efficient].

policies that admit only those patients whose treatment falls within the GHM framework at the expense of others (risk aversion). Moreover, other effects, such as financial pressure and its impact on staff, the incentive to increase activities while reducing costs, and up-coding, have been identified in the literature (Angelé-Halgand 2015; Angelé-Halgand & Garrot 2014; Georgescu & Hartmann 2013; Georgescu & Naro 2012).

The effects associated with control over expenditure

The fact that no activity threshold is applicable in the implementation of activity-based tariffs has encouraged some institutions to expand their operations, notably the most profitable ones (through the selection of patients) to the detriment of other institutions that do not practice this policy. Moreover, introducing funding to hospital activities may shift the balance of care between hospitals and the ambulatory sector and thus impact medical costs in local medical care (Cash *et al.* 2003 cited by Or and Renaud 2009). Ultimately, the whole community may be affected by this situation.

Activity-based tariffs are based on a full cost-based system and draw on the method of the identification of homogeneous sections (Angelé-Halgand & Garrot 2014; Moisdon 2015; Moisdon & Pépin 2010). However, much criticism has been levelled against this method because of the obstacles encountered in effectively allocating costs, especially indirect cost objects, and the difficulty associated with avoiding cross-subsidisation. Activity Based Costing has thus gained favour. The literature also emphasises the poorer accuracy of the results of cost calculations obtained (De La Villarmois & Levant 2010). Activity-based tariffs neither reflect, nor do they cover the real consumption of resources (Angelé-Halgand & Garrot 2014; Moisdon 2015). Activity-based tariffs are no longer adapted to current mutations in the health system (Angelé-Halgand & Garrot 2014; Kaplan & Porter 2011; Kaplan & Witkowski 2014).

1.2.2. Research question

The changing health sector described above has led to a paradigm shift in patient care. Faced with an ageing population and budget constraints, the challenge now lies in addressing chronic disease and the discourse advocates approaches that focus on comprehensive patient management. Through Thomas Le Ludec, previously in charge of improving the quality and safety of healthcare, the HAS has made it clear that, "*Today, with the ageing of the population, 15 million French are suffering from chronic illnesses, among whom 9 million require long-term care. These chronic patients are witnesses to the workings of our healthcare system: they are the first to perceive the divisions between the different links represented by the hospital, local medical care, and the medico-social sector.*"[5] A healthcare pathway thus appears as a solution to decompartmentalise the different links involved in providing healthcare and creating value.

The limitations of activity-based tariffs have been exacerbated with the paradigm shift to the healthcare pathway approach, raising the question of the right tool for cost calculation. The literature suggests that cost calculation methods such as Activity Based Costing (ABC) may be more appropriate for the health sector (Mercier 2012; Nobre & Biron 2002). As Nobre and Biron (2002) note, "*ABC emerged in the Anglo-Saxon hospital system as an alternative to the traditional cost system*". However, when it comes to implementation, ABC is not without its limitations: highly complex, difficult to update, and cost evaluation errors (De La Villarmois & Levant 2007b, 2007a; Kaplan & Anderson 2008). Could an alternative cost-per-activity approach, i.e., Time Driven Activity Based Costing (TDABC), be more adapted to healthcare pathways?

5 Newsletter of the French National Authority for Health • n° 36: [http://www.has-sante.fr/portail/jcms/c_1616095/fr/des-parcours-de-soins-pour-un-systeme-de-sante-plus-efficient]

2. THEORETICAL FRAMEWORK: the value of healthcare pathways in terms of costs

TDABC, a variant of ABC, is a tool for modelling the cost-value relationship. After putting into perspective the difficulties associated with evaluating the value of healthcare pathways (2.1), we will present the methodological approach of TDABC for cost measurement (2.2).

2.1. From value to the value of a healthcare pathway: ambiguous concepts

2.1.1. From multiple approaches to value...

In the healthcare pathway approach, creating 'value' for the patient raises questions as to how one might define this term. The definition of value is still the subject of much debate. Indeed, this word is marked by ambiguity and subjectivity (Huron & Spieth 2013; Malleret 2009; Wellhoff 2009). Wellhoff (2009) points out that, "*Ever since its emergence from the Latin word 'valor' in the 11th century*, [the word value] *designates either the price of a good, its assessment from an economic perspective, or the bravery or warrior virtue of a man. The term thus covers both a concrete and rational representation (cost of a good) but also something less rational, more abstract.*"

Malleret (2009) mentions that in 1776 Adam Smith proposed two approaches to value, i.e., use value and exchange value. Malleret (2009) offers an additional approach which presents value as the result of a social construction. She thus calls attention to the fact that use value reflects the value an individual gets from an object (neoclassical approach). The exchange value is expressed in monetary terms and can be likened to prices. However, two trends oppose this representation. According to Malleret (2009), some authors consider that price is an indicator of value. They argue that the "*price a customer is willing to pay neither corresponds to the market price nor to the price he or she eventually pays*" (p.12). However, other authors, generally those in the strategic and marketing fields, consider that price is an attribute of value. Malleret points out that while some of these authors define value as that which is "*perceived by the customer*" (p.14), this value "*does not exist as such*" (p.14), but rather refers to "*a judgement*" (Barwise and Meehan 1999 cited by Malleret 2009, p.14), or to "*the mental representations of customers depending on their expectations*" (Jallat, 2002 quoted by Malleret 2009, p.14). In this trend, "*Value is defined in relation to various competitors' offers. The perceived value of an object (product or service) can decrease even if its attributes remain unchanged simply because the competitor has changed his or her offer*" (Teller 1999 cited by Malleret 2009, p.14). Her synthesis clearly reveals that some authors are divided between these two approaches, indicating, among other things, the difficulty associated with the definition of 'value'.

In the third approach, proposed by Malleret, value stems from a social construction, reflecting the fact that it lies outside the institution. It is the result of a double determination, i.e., the market and a customer's preferences. Other authors, cited by Malleret, seem to edge in the same direction. Indeed, they show that "*Value, considered from an organisational perspective, is in reality given and built as much by actors, and in particular by organisations, as by markets*" (Bréchet and Desrumeaux 2001). Similarly, "*Products have value if they offer one of more functionalities, i.e., the ability to respond to a social group's needs*" (Lorino 1995 cited by Malleret 2009, p.14). Malleret adds that, "*The value a customer attributes to a good or service is linked to his or her socioeconomic environment and to his or her 'system of values'*", and that it varies widely (p.15). Huron and Spieth (2013) suggest that value is plural and one must thus speak of 'values'. They have identified three approaches to value which intersect with the New Public Management approach, i.e., the standard value (benchmark), the economic value (truth) and the real value (desire). A study undertaken on the value-based management of an accounting firm's performance revealed three other approaches to value: the shareholder value, the value of partnership and the cognitive value (Charreaux 2002; Charreaux & Desbrières 1998; Pendaries & Pendaries 2012).

2.1.2. ... to the value of a healthcare pathway

In the health sector, Nobre (1998) used value as conceptualised by Porter to analyse the production of value in a hospital setting (p.121). Porter defines value as "*what buyers are willing to pay, and superior value stems from offering lower prices than competitors for equivalent benefits or providing unique benefits that more than offset higher price.*" Applying this definition to the public health sector led Nobre to point out the significance of the role a hospital plays as the "*guarantor of the overall health of the population in the geographic zone for which it is responsible*", a role reinforced by the launching of GHT. He emphasised that, "*The patient is not the final payer and that supervisory authorities seek to obtain a package of services at a minimum cost*", and concluded that, "*Increasing the value produced by the hospital either refers to increasing patient satisfaction at a constant cost, or reducing costs but maintaining the same patient satisfaction.*" (Nobre 1998, p. 122) Nobre underscores the soundness of this conception of value based on the changes observed in hospital management at the time, i.e., the introduction of a synthetic index of activity (*indice synthetique d'activite* - ISA) and the promotion of the respect of the standards of good practice and of quality. He argues that these changes have encouraged hospitals to reduce their costs for the same activity or to expand their operations in order to better meet patients' expectations with an unchanged budget and without forgetting the quality dimension.

Nobre's observation is as important today as ever insofar as activity-based tariffs encourage hospitals, irrespective of the few resources available to them, to expand their operations in order to increase funds. Similarly, certifications from the French National Authority for Health measuring the qualitative dimension of the services hospitals propose have become an obligation. However, the paradigm shift following the prevalence of chronic diseases and the emergence of the healthcare pathway approach requires the development of a conceptual framework that effectively reconciles both the qualitative (value for the patient) and quantitative aspects (cost reduction) and integrates the cross-sectoral vision of patient management advocated by health authorities (Ministry of health, HAS, ARS).

The conceptual framework proposed by Porter and Kaplan appears to correspond to this shift. Indeed, Porter revisited his approach to value and, together with Kaplan, they proposed an adaptation relevant to the health context (Kaplan & Porter 2011; Porter 2010). They presented the value of care as the result of care achieved depending on the means implemented to ensure achievement. The results of care revolve around three points:

- Survival / autonomy.
- Time required to achieve complete or partial recovery / Disutility of the care or treatment process (discomfort, retreatment, short-term complications).
- Sustainability of health: recurrences of the original disease, new health problems created as a consequence of treatment.

The value of care pathway is inherently ambiguous and very difficult to quantify. This raises fundamental questions: when and how should this be assessed? What terms should be used considering that human life has no price? Keeping the value of care pathways in the background, we focused on cost measurement and, in particular, on the applicability of Time-Driven Activity-Based Costing (TDABC) to the healthcare pathway. TDABC (Kaplan & Porter 2011; Kaplan & Witkowski 2014) is a cost calculation method developed to estimate the means implemented.

2.2. The measurement of costs using the Time-Driven Activity Based Costing (TDABC) method

TDABC is a variant of the Activity Based Costing (ABC) method. Like the ABC method, it is a process-based approach. It was developed by Kaplan and Anderson in 2004 following the criticism levelled against ABC concerning its complex implementation and difficulties associated with updating data(De La Villarmois & Levant 2007a, 2007b, 2010; Domingo *et al.* 2015; Kaplan & Anderson 2004, 2008), particularly in the field of health (Domingo *et al.* 2015). The literature review revealed that TDABC has a number of advantages over

other full-cost methods (ABC, analysis centres, UVA method and method of coefficients). These include: simplicity and precision, easy maintenance, simpler to share a common vision, and the possibility of simulation and benchmarking (Domingo *et al.*, 2015).

The TDABC approach first requires a process map and a modelling process defined as "*a set of activities organised over time and producing specific and measurable results*" (Fernandez 2013, p.198). There are two important parameters that must be taken into account at every phase of the TDABC approach. These are the cost estimation of each resource used and the available capacity of time resource. The key phases in the implementation of TDABC are described below:

The process map and the patient management process are decisive. A process map requires to take note of the existing process maps in the organisation, or, if these are unavailable, to develop it based on the organisation's documents and on interviews with the key players. The identification of the resources expended (human and material resources) at each phase of the process occurs over a given period. The estimation of the available capacity of resource refers to the determination of the total time (human) devoted to activities involving the provision of healthcare. Finally, the time equation makes it possible to model the costs of resources expended for each task in the process.

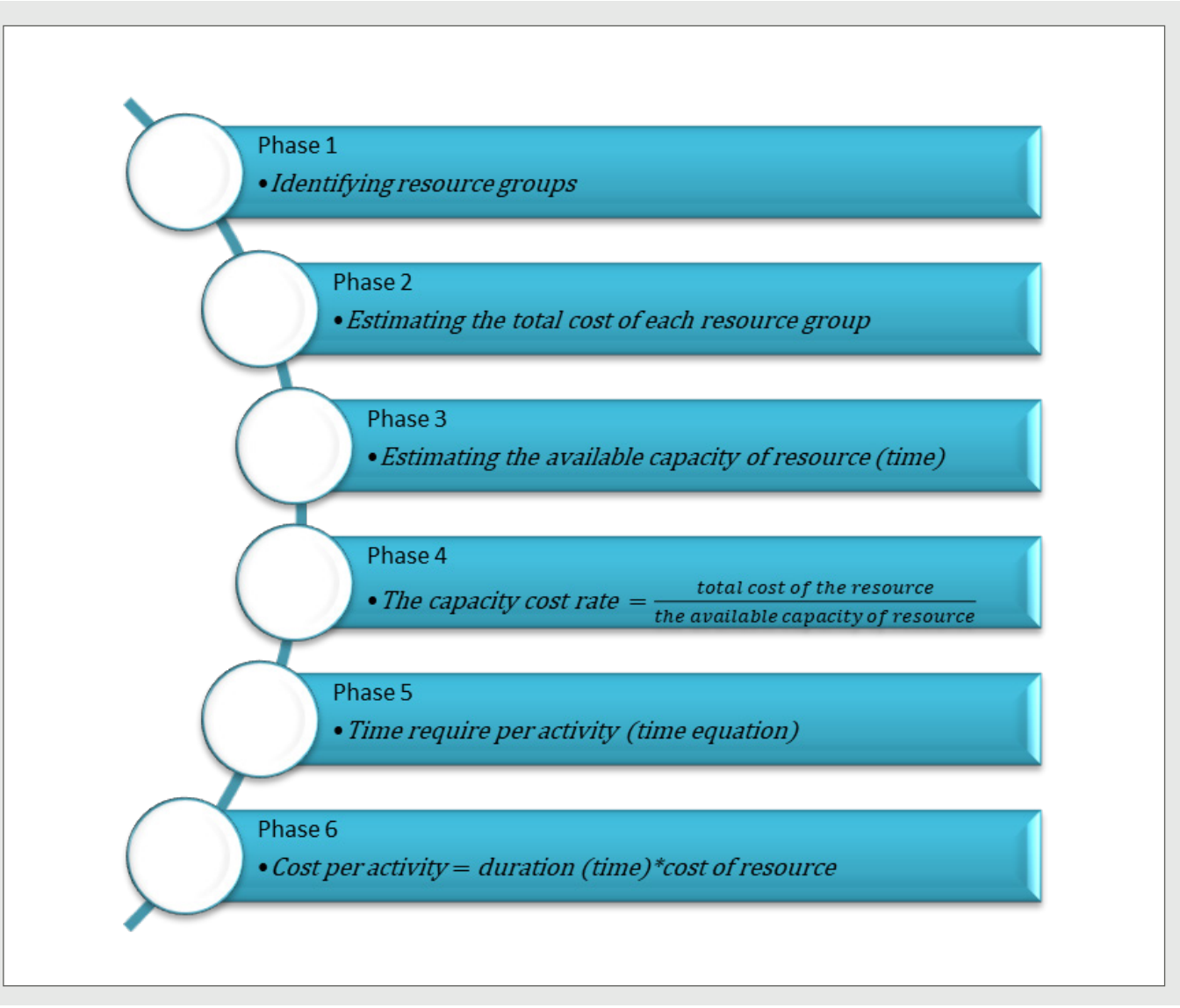

Figure 1 – Key phases in the implementation of TDABC

Source : Everaert, Bruggeman, Sarens, Anderson & Levant, 2008.

3. METHODOLOGY

First, we will present the terms of our study in a referent university hospital center for stroke (3.1). Second, we will elaborate our approach to identify and delineate high value pathways (3.2), and to implement TDABC to these pathways (3.3).

3.1. Action research in a referent university hospital center for stroke

This study is part of a research action defined as "*a method of research where creating a positive social change is the predominant force driving the investigator and the research*" (Berg & Lune 2011, p. 196). The objective of this study, undertaken within a university-affiliated hospital (CHU) over a three-year period, was to explore whether or not a cost calculation of a chronic disease care pathway was possible by using a method other than the traditional methods used in the health sector - notably in hospitals - which hardly take transversality into account (Colasse 2011). The overall approach consisted in identifying a chronic pathology (high frequency and costly). We chose to focus on the stroke and, in particular, on cerebral infarction in patients. Indeed, there are three different types of strokes:

- cerebral infarction (ischaemic stroke) represents 80% of all strokes. It results from the obstruction of an artery in the brain by a thrombus (blood clot) which interrupts the supply of oxygen to the brain;
- hemorrhagic stroke: represents 15% of all strokes. It is caused by a rupture of an artery in the brain causing a hematoma;
- subarachnoid hemorrhage: represents 5% of all strokes. It is caused by a ruptured aneurysm, the rupture of an artery located on the surface of the brain, i.e., between the skull and the brain.

Strokes are the third biggest killer in France in general and also in the department where this study was undertaken. It is one of the priorities of the Regional Public Health Authority representing this department. We also chose this pathology because of the characteristics of our field of study: a university-affiliated hospital to which patients with strokes are referred.

STAKEHOLDERS	NUMBER
Deputy Director-General	1
Administrative and financial director	1
Head of management control and his assistant	2
One head of unit	1
Administrators of the unit	1
Senior health manager	1
Health managers	4
Doctors in charge of the unit and stroke pathway care	7
Heads of clinics	2
Department of Medical Information	3
ARS regional coordinator of strokes	1

Table 1 – The stakeholders met before the data collection phase

Following this choice, we met with key players in order to explain both our research question and our approach. This relatively long phase made it easier to access the field of study for data collection purposes.

After meeting the different stakeholders, we began observing and collecting data for the pathway, being finalised for the part after patients had been discharged from the head and neck emergency department.

3.2. Delimiting high value pathways

A priori, one might consider that chronic disease care pathways are relatively similar. However, results show that multiple pathways are possible. We had initially decided to apply what ARS proposes as the definition of care pathway, i.e., whenever a patient receives care from healthcare professionals (within the university-affiliated hospital in our case).

First, we took advantage of the data provided by the Medicalisation programme of the Information System (*Programme de Médicalisation du Système d'Information* - PMSI) in collaboration with the Department of Medical Information (Département de l'information médicale - DIM). We sought to identify all patients who had received treatment for ischemic strokes over a specific period (2013), as well as their care pathways in the different medical units (departments) of the CHU. The objective was to obtain a matrix with patients (in the rows) and CHU medical units - and thus departments - that provide healthcare (in the columns). We began by observing patients' care pathways. After discussions with the DIM on the method's operationalisation, it was decided that an analysis based on diagnosis related groups (DRG) would be more relevant. Coincidentally, this is the dominant data management approach used in care facilities and within the ARS as well. For 2013, the study led to identify 922 stays, among which 889 patients received treatment for ischemic stroke. Each stay required patients to pass through a chronological sequence of medical units. From the 323 pathways identified by grouping similar hospital stays, this figure dropped to 208 pathways when data from where patients were from (home, other healthcare institutions, etc.) and their destination (home, other institutions, etc) was excluded. An initial analysis of care pathways in Medical, Surgical, and Obstetrical ward units revealed that the phase most valuable to patients, irrespective of the mode of entry, was when specialised units such as the department of neurology were directly responsible for their care.

The second approach involved discussing with the healthcare stakeholders on the ground, which we did by becoming fully engaged in the different departments. This approach revealed the existence of an 'ideal' care pathway and an 'impaired' pathway as a result of misdiagnosis or the misorientation of patients. Taking into account the flow of patients in this pathway, this paper will focus on the ideal pathway in terms of the value created for the patient.

To ensure feasibility and in agreement with the healthcare professionals, we initially focused on the section of the pathway with the highest value:

Emergency Head & Neck ➔ Imaging ➔ Emergency head and neck ➔ Discharge

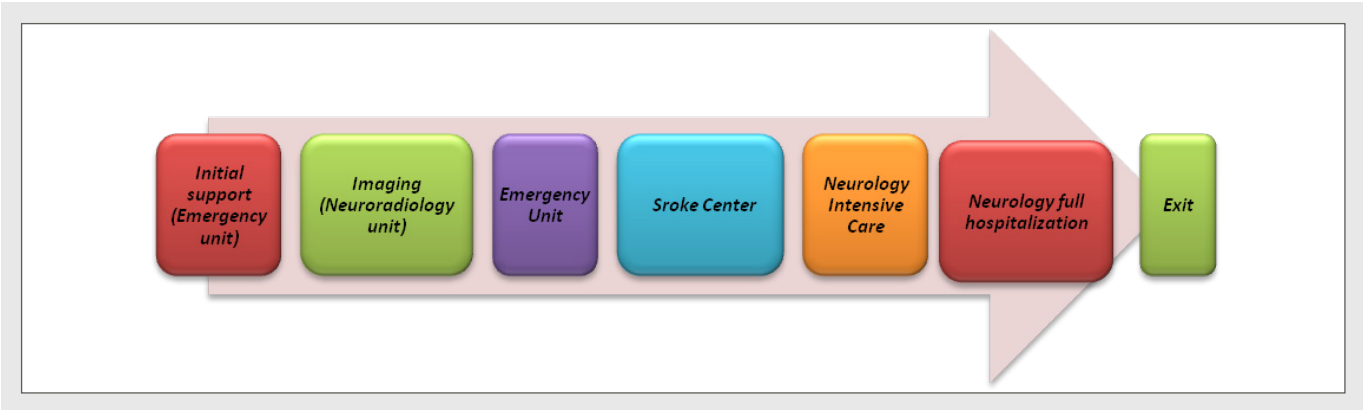

Figure 2 – Ideal pathway "Emergency Head & Neck"

This phase of the care pathway corresponds to the initial phase of care up to the diagnosis, a phase in which the rapidity and suitability of care is crucial for the patient's survival and his or her degree of health or recovery. The rapidity and suitability of care reduces the time and costs required to achieve complete or partial recovery and ensures the sustainability of the patient's health status.

3.3. Implementing TDABC to the ischemic stroke care pathway

The development of a process map by following the steps presented earlier (Figure 1) is a first step towards the implementation of TDABC.

Process map

The first phase of engagement involved 146 hours of direct observation of the care different professionals (nurses, orderlies, neurologists, emergency physicians, speech therapists) proposed to patients, and participation in various department meetings. We also took advantage of the available materials (protocols of care) to identify and map out the main activities and tasks, which amounted to 279 for the entire pathway. However, we will only present activities and tasks relating to the section of the care pathway selected for this article. After analysing these materials, the process map was presented to health officials, doctors, nurses and auxiliary nurses for validation. Mapping took into account the main activities: the reception of the patient and the clinical entrance examination, imaging and the interpretation of the results, thrombectomy (a technique to remove clots inside an artery) and the re-examination of the patient before his or her transfer to a different unit or before he or she is discharged from the hospital (see Annex 2: activities and tasks columns).

Estimating cost-per-activity to formulate the equation of time

To determine the cost-per-activity, we collected the costs of different resources (by category of employees, among other categories) from the management control department. These costs accounted for approximately 90% of personnel expenses. To estimate the available capacity of resources, we used the 0.8 coefficient theorised by those who developed TDABC in order to account for the time that was not directly assigned to healthcare activities (meetings, breaks, etc.). Management control data and the assessment of the available capacity of time resource thus allow to calculate the capacity cost rate for each resource category (see Annex 1).

To determine time by both activity and task, we observed close to 136 hours of the care patients received. We selected ten cases where the final diagnosis was ischemic stroke. Time structural equation modelling was undertaken by taking into account the time required for each task, which was measured by timing the 10 selected patients. As a precaution, we consulted the health professionals to verify that the time identified was consistent with their own observations. These different phases made it possible to assess the cost-per-activity and cost-per-task (see Appendix 2: cost column) to develop the time equation for strokes.

4. RESULTS AND DISCUSSION

The results showed that the cost-per-task follows the Pareto law, which makes simplification possible (4.1). Admittedly, TDABC has a number of limitations related to the measurement of time. However, it allowed us to highlight the "hidden costs" associated with the unavailability of resources (4.2).

4.1. TDABC: possible simplification through the Pareto law

Identified tasks and activities were coded to allow the formulation of time equations. An element's apparition determined whether or not its value was null. For example, the activity "receive the patient" was represented as follows, knowing that βi represents the time assigned to the task. The value of this time was subsequently determined based on the αj cost of resources used. This activity was undertaken by the nurse or orderly in charge of the patient.

$$\beta i X_9 \ (receive\ the\ patient) =$$

$+\beta iajX_{10}$ (*settle in the patient*)
$+\beta iajX_{11}$ (*verify patient identity and put on the bracelet*)
$+\beta iajX_{12}$ (*help the patient undress and wear the hospital shirt*)
$+\beta iajX_{13}$ (*remove all metallic objects and jewellery*)
$+\beta iajX_{14}$ (*verify the hearing and dental appliances*)

Based on the cost of resources provided by the management control department (Annex 1), below is the overall equation (**E**) modelling a section of the stroke care pathway:

$$\mathbf{E_x} = 1{,}69X_1 + 1{,}58X_2 + 5{,}5X_3 + 1X_4 + 1{,}33X_5 + 2X_6 + 2X_7 + 1X_8 + 2{,}21X_9(0X_{10} + 0X_{11} + 1{,}5X_{15}) + 2{,}25X_{16} + 3{,}22X_{17}(0X_{18} + 0X_{19} + 0X_{20} + 0X_{21}) + 4{,}8X_{22} + 0X_{23} + 6{,}4X_{24}(0X_{25} + 0X_{26}) + 5{,}53X_{27} + 1X_{28} + 1X_{29} + 3X_{30} + X_{31}(1X_{32} + 15{,}12X_{33} + 0X_{34} + 3{,}25X_{35} + 1{,}6X_{36} + 4{,}2X_{37} + X_{38}(2{,}5X_{39} + 0X_{40} + 0X_{41}) + 24{,}21X_{42} + 0X_{43} + 19X_{44} + 10X_{45} + 0X46 + 2{,}1X_{47} + 5X_{48} + 2X_{49} + 2{,}5X_{50} + 3{,}5X_{51} + 21X_{52} + 18X_{53} + X_{54}(2X_{55} + 5X_{56} + 0X_{57} + 2X_{58} + 2X_{59} + 3X_{60} + 0X_{61} + X_{62} + X_{63} + X_{64} + X_{65} + X_{66} + 2X_{67} + 2X_{68} + 4X_{69} + 2X_{70} + 5X_{71}) + X_{72}(5X_{73} + 2X_{74})$$

Table 2 summarises the constituent elements of time equations and their associated costs by paying particular attention to elements whose cost is superior to €10. The healthcare cost in the head and neck emergency department alone was approximately €425, with six tasks among the 74 tasks identified, representing, when combined, more than 81% of the costs: request imaging €17, neurological examination €81, interview with the family €23, interpretation of the results of imaging €102, updating patient records and prescription DxCare €27, and re-evaluation of the patient's condition before his/her release (to another service or back home) €97. These results suggest that the method may be simplified by using the Pareto law, i.e., by focusing on the 10% of tasks representing more than 80% of the costs. To identify the total cost, one must thus consider that the other resources are indirect costs.

MIN	CODES	ACTIVITIES AND TASKS	COST
	X_{31}	**Clinical examination before admission**	
15,1	X_{33} X_{34}	Neurological examination (*record the history of the disease and execute the NIHSS*)and complete the medical file (DxCare/Resurgence) Carry out the general review and verify the inclusion criteria	€81,39
3,25	X_{35}	**Request imaging**	€17,49
4,2	X_{37}	**Hold a meeting with the family** Obtain information about the patient's history, treatment, circumstances surrounding the onset of illness	€22,61
19	X_{44}	**Interpret the results of imaging and diagnosis (neurological examination…)** Make a decision about therapy	€102,27
5	X_{48}	**Update the medical file and write out a prescription on Dxcare**	€26,91
21	X_{52}	**Prepare the patient for thrombectomy** Prepare a nasogastric tube or ureteral catheter if necessary Groom the patient Take note of what has remained constant Transcription using the RESURGENCE software	€12,09
18	X_{53}	**Reexamine the patient before his/her transfer or discharge**	€96,88
2	X_{67}	Prepare for ambulance call (*only for patients being transferred outside CHU or back to their homes*)	€10,76
		Subtotal cost activities/tasks > €10	**€370,40**
		Cost of other activities and tasks	**€54,88**
		Total excluding indirect charges	**€425,28**
		Indirect costs distributed across the number of patients treated	**€12,96**

Table 2 – Cost-per-activity and cost-per-task of care pathways

This analysis on the high value section of the care pathway reveals that the TDABC approach makes it possible to model costs while taking account of the execution of specific acts and possible changes (new activities or tasks), as many authors have pointed out (De La Villarmois & Levant 2007a, 2007b; Demeere, Stouthuysen, & Roodhooft 2009; Kaplan & Anderson 2004, 2008; Siguenza-Guzman *et al.* 2013). According to La Villarmois and Levant (2007b, p.31), "*The TDABC model is an easier cost evaluation system to set up and maintain, accurate, and capable of grasping the complexity of the use of capacities*". These authors argue that TDABC opens up the possibility of modelling complex operations as well as of simulation and benchmarking. Organisations can use the simulation option proposed by TDABC to analyse and optimise the consumption of resources (Everaert *et al.* 2008). Lastly, this study shows that TDABC can be used to model the care pathway, which opens horizons for future studies in the health sector. Indeed, in their literature review of health facilities, Siguenza-Guzman *et al.* (2013) identified only a few studies (two that did not deal with logistics) which had implemented TDABC across an entire hospital department.

4.2. The TDABC: limitations and perspectives

Research has highlighted several limitations associated with TDABC. First, value may be difficult to identify. It is possible to assess across different scales the three criteria of value of a healthcare pathway, i.e., survival and the degree of health or recovery, time required to achieve complete or partial recovery, and sustainability of health. However, any attempt to enhance value by applying monetary terms to these three criteria is highly risky. Research nonetheless shows that the cost, which is approximately €425, is low compared to the important issues at stake for the patient. Indeed, the speed and quality of diagnosis determine the patient's health. Depending on the patient's condition, prompt care allows a significant reduction of sequelae and therefore all future costs of rehabilitation (rehabilitative care can sometimes extend for over a year, or local medical care in less serious cases), and may even allow patients to return to a quasi-normal life style in a relatively short time.

When dealing with strokes, the operationalisation of TDABC is rather complex. Indeed, our study highlights the extent to which pathways differ (323 pathways for 889 patients) for the treatment of the same pathology. This implicitly reflects a lack of homogeneity between patients and is inconsistent with what the notion of activity-based tariffs suggests. Moreover, it also highlights the complex implementation of TDABC.

Although TDABC makes it possible to model costs, it is worth mentioning that it also has several limitations related to the difficulties associated with the measurement of time. As some authors have pointed out, the phase involving the development of a process map and the measurement of time use up resources (Gervais, Levant & Ducrocq 2010). Moreover, Villarmois *et al.* (2007a) point out that measuring the time spent in service delivery is complex because this time remains unclear and unstable in tertiary activities. Hospital operations are characterised by this time variability, especially emergency operations. Indeed, depending on the clinical condition of the patient, the signs of a stroke may vary from a clinical perspective. Moreover, the time required for blood sampling may vary from simple to double depending on the state of the patient (whether or not the vein is easily identifiable) and the experience of the paramedical staff. In other words, one must take into account the complexity coefficient (the state of the patient) and the competence coefficient (qualification of personnel). The literature on TDABC overlooks this issue.

Moreover, other factors also have an impact on this time, notably dysfunctions arising from cooperation and coordination problems between different professionals (nurse, orderly, vascular neurologist, neuroradiologist, radiology technician) and medical departments across the healthcare pathway. In case of transport unavailability (internal, ambulance services) or misorientation, queues of patients to be transferred out of the institution or to other services may develop, creating an additional need (notably the consumption of human resource) as these patients must be dealt with. Each medical department has its own operations, its own constraints (profitability), and its own patients to treat. Diagnostic imaging is thus perceived as an emergency situation when a stroke is suspected. The Court of Auditor

(2010) has called attention to the importance of imaging in the diagnosis of cerebral infarction and the challenges posed for the patient when imaging is delayed. The implementation of TDABC generates much dialogue with health professionals, who highlight the difficulties associated with budgetary pressures and thus unavailable resources, generating direct additional costs in the head and neck emergency department. Moreover, there is also a psychological workload that is not reflected in TDABC.

In addition to these immediate additional direct costs, the unavailability of resources generates future costs across the entire care pathway: more costly rehabilitative care if medical imaging is delayed or if sessions with physiotherapists or speech therapists are not proposed in time because of unavailability. TDABC thus paves the way for interesting prospects. Extending the study to the entire care pathway and the potential simulation with TDABC may make it possible to reveal that both patients and the entire health system incur significant costs over the long term if certain resources are unavailable. Healthcare professionals specialised in neurology have underscored the need to begin physical and speech therapy sessions as soon as possible because this may allow the patient to regain a degree of health or recovery, and therefore make significant savings in care pathway rehabilitation costs. These sessions, which are not always possible because of a lack of resources, come in at a much lower price compared to the much greater rehabilitation costs. In other words, simulation may make it possible to manage resources in a way that takes into account the negative impact of savings achieved by a given department on the cumulated costs of the entire healthcare pathway.

Another interesting point is that TDABC allows us "*to approach the accounting process to people without experience in accounting, business or finance. TDABC also allows us to improve the understanding of the different organisational processes through the lens of an accounting technique*" (Siguenza-Guzman *et al.* 2013). Indeed, our study shows that once the codes of entry to hospitals are respected, healthcare professionals, irrespective of their workload, accept the presence of a researcher specialised in management and freely explain their activities and their jargon. They tend to be receptive to a system of cost calculation that is more in line with their operations, a system they understand, and one that 'speaks to them' more than national cost-of-illness studies or the analytical accounting system of hospitals, which is impermeable to healthcare professionals. Almost all health professionals claim the process map represents the reality of patient management situations. They take ownership of this management tool, which also reveals the 'hidden costs' (Savall 1987) of the unavailability of resources or coordination problems, issues which they encounter daily.

Despite these multiple limitations and a relatively complex and cumbersome method, TDABC allows estimation of the cost if a patient is admitted to the head and neck emergency department. It may be simplified if one focuses on the tasks that consume the most resources. In our case, among the 74 tasks identified, six represented more than 80% of the costs.

CONCLUSION

Meyssonnier and Nobre (2015, p. 218) advocate management control in support of action: "*Faced with limited public resources and the expectations of citizens, both taxpayers and users, it is essential to develop management control in support of action and a results-oriented culture at all levels of management of these organisations in order to deliver real value*". By proposing to define this value in the context of health and providing a tool for cost calculation, the conceptual framework of Porter and Kaplan may provide part of the answer.

This study, which is limited to the care pathway in the "head and neck emergencies" department, shows that implementing the TDABC method is possible for chronic disease care pathways such as ischemic stroke, a care pathway that has become increasingly prevalent in the health system. Another quality is that unlike the management control tools used in hospital settings, this method is understandable and has sparked the interest of health professionals. It shows the savings (unavailable resources) that may generate much larger costs (rehabilitative care) over the long term. The method also shows the need for effective cooperation between the different healthcare professionals involved throughout the care pathway to prevent obstacles and improve patient management. To take this study further, we have undertaken a second study that analyses professional practices in order to better understand the obstacles and determine the actions that could be taken.

However, the implementation of TDABC requires the mobilisation of significant resources and assumes that a major activity has been undertaken beforehand, i.e. the development of a process map given the multiple possible pathways for a same pathology, which calls into question the very concept of diagnosis related groups. Lastly, TDABC has several limitations: there is a need for many resources, it does not take into account factors such as the patient's condition and the experience of the health professionals, and, especially, there is a difficulty associated with quantifying the value of the care pathway or even the psychological load of work. Despite these limitations, the findings open new research perspectives: a comparison of the costs obtained with those obtained from analytical accounting in hospital settings, simulating the hidden costs associated with performance bottlenecks or with the non-availability of resources, or enable reflection on the implementation of TDABC in order to devise lines of action to facilitate and ease the operationalisation of TDABC.

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APPENDIX 1

AVAILABLE CAPACITY AND TIME UNIT (MIN) COSTS PER RESOURCE GROUP

Resource groups	Full-time equivalent (FTE)	Equivalent in hours	Practical capacity in hours	Practical capacity in minutes	Cost per year	Cost per minute (€/min)
Administrative staff	4,00	7280	5824	349448	48525,80€	0,14€
Paramedical staff	21,46	39058	31246	1874787	1079570,20€	0,58€
Management staff	1,00	1820	1456	87362	67030€	0,77€
Emergency medical staff	3,88	6332	5066	303944	366482€	1,21€
Medical Staff Neurologist	1,12	1828	1462	87736	472233€	5,38€

APPENDIX 2

COST AND TIME PER ACTIVITY AND TASK OF THE CARE PATHWAY (DETAILED PRESENTATION)

MIN	Codes	ACTIVITIES	TASKS	COST
1,69	X_1	**Receive the call and collect various information in the call book**	*Collect information*	2,03€
1,58	X_2	**Alert the various professionals (Neurovascular intern, Neuroradiologist) and request an MRI and provide a resuscitation room**		1,90€
5,50	X_3	**Prepare the nursing station for the reception of the patient**		3,17€
1,00	X_4	**Check and get medical equipment and devices ready such as : Monitoring System, Physiologic; suction unit, oxygenation equipment, emergency blood test kit for stroke (Hematology, Biochemistry, Toxicology) etc.**		0,58€
1,33	X_5	**Inform the various actors (emergency physician, intern in neurology intern) of the patient's arrival**		0,77€
2,00	X_6	**Create the administrative admission file (with PASTEL software)**		0,28€
2,00	X_7	**Create the medical file (with RESURGENCE software)**		0,28€
1,00	X_8	**Inform the resuscitation team of the arrival of the patient's family**		0,14€
2,21	X_9	**Welcome the patient**		1,27€
	X_{10}		Prepare the patient	
	X_{11}		Check identity and put on bracelet	
	X_{12}		Help to undress and put on the hospital shirt	
	X_{13}		Remove metal objects (jewelry)	
	X_{14}		Check the hearing and dental apparatus	
1,50	X_{15}		Make an inventory of the patient's belongings, deposit in the safe if necessary	0,86€
2,25	X_{16}	**Assess vital functions**	Gather baseline information and do a neurological assessment with the NIHSS Scale for nurse	1,30€
3,22	X_{17}	**Equip the patient with monitoring systems**		1,86€
	X_{18}		Place the electrodes and the blood pressure monitor	
	X_{19}		Put pulse oximeter	
	X_{20}		Put Monitoring System, Physiologic	
	X_{21}		Take the constants (body temperature, blood pressure, oxygen saturation, heart rate, breathing rate) Evaluate pain level (with a patient-specific scale) and ask for weight.	

MIN	Codes	ACTIVITIES	TASKS	COST
4,80	X_{22}		Poser la sonde nasogastrique (SG) en cas de vomissement ou inconscience du patient	2,76 €
	X_{23}		Poser la sonde vésicale (SV) si patient inconscient	- €
6,40	X_{24}		Poser la VVP (Voie Veineuse principale)	3,69 €
	X_{25}		Effectuer les prélèvements sanguins (SOS AVC) et Réaliser une glycémie capillaire	
	X_{26}		Conditionner et envoyer les examens biologiques en urgence	
5,53	X_{27}		Poser l'ECG et Pratiquer l'Électrocardiogramme (ECG)	3,19 €
1,00	X_{28}		Administrer l'oxygène si nécessaire	0,58 €
1,00	X_{29}		Récupérer les résultats des examens (via le logiciel)	0,58 €
3,00	X_{30}	**Renseigner le dossier paramédical (via le logiciel RÉSURGENCE)**		1,73 €
	X_{31}	**Procéder à l'examen clinique d'entrée**		
1,00	X_{32}		Faire le premier examen et prendre en charge des détresses vitales (respiratoire, cardiaque, ex : coma)	1,21 €
15,12	X_{33}		Faire l'examen neurologique (*Recueillir l'histoire de la maladie et Exécuter le NIHSS*) et remplir le dossier médical (DxCare/Résurgence)	81,39 €
	X_{34}		Faire l'examen général et Vérifier les critères d'inclusion	
3,25	X_{35}	**Demander l'imagerie**		17,49 €
1,60	X_{36}	**Préparer et Accompagner le patient à l'imagerie (en cas d'intubation, ventilation ou instabilité)**	Vérifier les contre-indications à l'IRM (métal, Pacemaker PM…)	0,92 €
4,20	X_{37}	**Faire un entretien avec la famille**	Rechercher les informations relatives aux antécédents, traitement, circonstances de survenue	22,61 €
	X_{38}	**Faire l'examen d'imagerie (IRM ou Scanner cérébral)**		
2,50	X_{39}		Vérifier les contre-indications à l'IRM (métal, Pacemaker) et l'identité du patient	
0,00	X_{40}		Informer le neuroradiologue et neurologue de l'arrivée du patient pour l'examen	
	X_{41}		Installer le patient	
	X_{42}		Lancer les séquences et acquérir les données	
24,21	X_{43}	**Traiter les données, reconstituer les images et les transférer dans le dossier médical du patient**		
19,00	X_{44}	**Interpréter les résultats d'imagerie et faire le diagnostic (évaluation neurologique…)**	Prendre la décision thérapeutique	102,27 €
10,00	X_{45}	**Dicter le compte rendu des examens d'imagerie et actualiser le dossier médical**		
	X_{46}	**Saisir le compte rendu médical**		

MIN	Codes	ACTIVITIES	TASKS	COST
2,10	X_{47}	**Ramener le patient au déchoquage (UTEC) ou à l'UNV (Stroke Center) ou en salle d'opération**		1,21 €
5,00	X_{48}	**Mettre à jour le dossier médical et faire les prescriptions sur Dxcare**		26,91 €
2,00	X_{49}	**Mettre à jour le dossier médical dans Résurgence et le clôturer**		2,41 €
2,50	X_{50}	**Mettre à jour le dossier paramédical dans Résurgence et le clôturer**	(Préciser le devenir du patient, résultat imagerie)	1,44 €
3,50	X_{51}	**Informer le patient (si son état le permet) et sa famille**	Donner les informations sur le diagnostic, le traitement, et le devenir du patient (continuité des soins…)	4,22 €
21,00	X_{52}	**Préparer le patient pour la trombectomie**	Sonder le patient (Sonde Nasogastrique ou Sonde urinaire) si nécessaire Faire la toilette du patient Prise des constantes Retranscription sur le logiciel RÉSURGENCE	12,09 €
18,00	X_{53}	**Réévaluer le patient avant sa mutation ou sortie**		96,88 €
	X_{54}	**Gérer les sorties de patients**		
	X_{55}		Déterminer le nombre de patients en partance (Vérification des avis de sortie du corps médical et du staff pluridisciplinaire)	1,15 €
2,00	X_{56}		S'assurer de la disponibilité d'une place en aval du parcours	2,88 €
5,00	X_{57}		Gérer les rapatriements intra ou hors France	
0,00	X_{58}		Informer la famille de la mutation du patient	1,15 €
2,00	X_{59}		Regrouper les effets personnels du patient	1,15 €
2,00	X_{60}		Préparer et imprimer le courrier médical de sortie (*Uniquement les patients en transfert hors CHU*)	1,73 €
3,00	X_{61}		Faire la demande de gravure [Graver les résultats d'examens d'imagerie sur cd (*Uniquement les patients en transfert hors CHU*)]	
0,00	X_{62}		Préparer et imprimer le dossier médical complet (*Uniquement les patients en transfert hors CHU*)	
	X_{63}		Préparer et imprimer la transmission ciblée de sortie dans DxCare (*Uniquement les patients en transfert hors CHU*)	
	X_{64}		Préparer et imprimer la fiche de liaison IDE ou Kiné libéral (*Uniquement les patients en transfert hors CHU ou vers domicile*)	
	X_{65}		Préparer l'ordonnance et rendez-vous de sortie (*précision des dates futures de rendez-vous*) (*Uniquement si sortie pour le domicile*)	
	X_{66}		Redonner le traitement personnel (*Uniquement si sortie pour le domicile*)	
2,00	X_{67}		Préparer le bon de transport ambulancier (*Uniquement pour les patients en transfert hors CHU ou vers domicile*)	10,76 €

MIN	Codes	ACTIVITIES	TASKS	COST
2,00	X_{68}		Commander le transport avec le logiciel PTAH (ambulance, si transfert vers un autre établissement / Transport CHU si mutation vers une Unité médicale hors filière Neuro)	1,15 €
2,00	X_{69}		Assurer le brancardage et récupérer le matériel (*lors de la mutation du patient au sein de la filière Neuro - intra CHU*)	2,30 €
4,00	X_{70}		Reporter les informations sur la mutation des patients dans DxCare et faire les mouvements de sortie dans DxCare	1,15 €
2,00	$X_{7}1$		Faire l'entretien de sortie	2,88 €
5,00	X_{72}	**Gérer le séjour aux urgences**		
	X_{73}		*Scanner les documents (résultats d'examens extérieurs, ECG, fiche pompier, Fiche SAMU ou d'ambulance, ordonnance) à mettre dans le dossier* *Vérifier le dossier pour clôture* *Générer le courrier pour signature et envoi* *Réédition étiquette*	
5,00	X_{74}		Valider le mouvement du patient dans DxCare lors d'une hospitalisation (entrée ou sortie du malade de l'UTEC pour le Stroke Center ou un autre service)	0,28 €

Total hors charges indirectes	**425,28 €**
Charges indirectes réparties sur le nombre de patients pris en charge	**12,96 €**