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Hospital Activity, Productivity and Quality of Care before and after Activity-based Funding (T2A)

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The activity-based funding (T2A) is used since 2004-2005, for financing acute hospital care in public and private hospitals with an objective to improve the efficiency of individual providers and the hospital sector as a whole. To date, however, the impact of T2A on hospital activity, productivity and quality of care has only been partially evaluated in France. This study provides new data and analyses for answering different questions: has the introduction of T2A contributed to increasing productivity of hospital sector? How has the production structure/*casemix* of different hospitals been modified? How has the quality of care been affected?

The results show that productivity in public sector hospitals increased steadily between 2002 and 2009 whatever the activity, but with a marked increase in surgical stays. In private-for-profit hospitals, we observe a significant increase in outpatient surgery and in parallel, a reduction in full-time hospitalisations in obstetrics and medicine.

Overall, we observe a positive trend in productivity of public sector since the introduction of T2A, while in private-for-profit sector there appear to be a change in the mix of care provided rather than a growth in total productivity. We also observe a significant increase in the rate of 30-day readmissions among patients receiving the main types of cardiovascular and cancer treatments. The analysis did not reveal a deliberate discrimination strategy against sicker and older patients, but a considerable increase in standardized rates for certain interventions or procedures that suggest the possibility of supplier-induced demand that is poorly or not at all justified.

Hospital care represents almost half (46%) of the health care consumption expenditure in France. While acute care is expensive in all countries, France allocates more resources to hospitals than the majority of OECD countries (OECD Healthdata 2012).

The activity-based funding (T2A, *Tarifification à l'activité*) was introduced in France from 2004-2005 to finance

short-stay hospital activities in both public and private sectors with the aim of improving the efficiency of individual hospitals as well as of the hospital sector. The principal behind T2A consists in remunerating each hospital stay according to a fixed rate determined *ex ante*. Hospital stays are defined by Diagnosis Related Groups (DRG) enabling the identification and classification of care delivered to patients with similar profile in economically homo-

geneous groups. In theory, this prospective funding system incites hospitals to improve the use of resources and to optimise the organisation of care to improve productivity (Shleifer, 1985). Previously, public hospitals were funded by means of an annual global budget which did little to incite efficiency, and private clinics by a somewhat inflationist fee-for-service and per diem system.

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DEFINITIONS AND METHODS

Productivity: productivity is the ratio between a measure of production (numerator) and a measure of the resources used (denominator). In sectorial analyses, we are typically interested in changes in overall productivity (growth rate).

Production: hospital stays are very different in terms of the resources used according to disease, the severity of the disease and patient characteristics (age, co-morbidities). The number of hospital stays weighted by the intensity of care delivered makes it possible to monitor changes in production by taking the *case-mix* structure into account. Two methods are used to calculate a hospital production index:

- **Synthetic Index of Activity (ISA, *Indice synthétique de l'activité*):** this is a synthetic measure of hospital production at constant prices grouping all stays with the same classification (V9). To each stay, we allocate a number of points reflecting the intensity of resource consumption using 2004 DRG (Diagnosis Related Groups) cost weights from the National Cost Study (ENC, *Etude nationale des coûts*, 2004). The sum of ISA points for hospital stays per facility provides a measurement of its overall production weighted by its *case-mix*.
- **Production Growth Index:** the number of ISA points calculated on a unique reference (V9 and cost structure 2004) does not permit describing changes in the value of production related to changes in the classification of DRG and the increase in costs. We calculated a production growth index (Laspeyres index) between two consecutive years. In the event of modifications in the classifications with the creation of new DRGs, there will be DRGs without a price in the preceding year (t-1). The method consists in imputing values where this information (on DRG cost) is missing.

Resources are measured in terms of expenditure (total expenditures and Public Health Insurance expenditures), hospital personnel (separating doctors, nurses and others) and the number of beds.

Entropy Index: a formula measuring concentration reflecting the *case-mix* dispersion (number of stays within a DRG) in hospitals. The higher the index, the more dispersed the type of care delivered at the hospital.

30 day hospital mortality rate: ratio between the number of deaths at the hospital during the 30 days following specific care (from the initial date of admission) and the number of stays for the type of care in question.

30 day readmission rate: ratio between the number of readmissions during the 30 days following the date of discharge from the hospital after the initial admission and the number of stays for the care in question.

The T2A, like all other forms of funding, can generate unwanted behaviours, or lead to perverse effects that have been abundantly described in the literature (Ellis and McGuire, 1996; Cots *et al.*, 2011). Patient selection, specialisation towards standardised care procedures, multiplication of technical procedures (better remunerated), upcoding disease severity, discharging or transferring patients prematurely and fragmentation of hospital stays are all examples of opportunistic behaviour frequently evoked in the literature. Furthermore, the sought-after efficiency at individual provider level is not always compatible with global objectives of allocative efficiency and cost optimisation. In order to optimise benefits, hospitals can increase the volume of poorly justified activities and modify the composition of care, by abandoning certain activities considered unprofitable by (at best) transferring them to pre or post hospitalisation structures. This can also create problems in the access to healthcare.

In order to ensure that financial incentives are in line with the aims of the reform, it is important to examine the evolution of hospital activity and its adaptation to needs as well as costs and the quality of care. To date, however, the impact of T2A on hospital activities has only been partially monitored. It is essential to carry out an objective, quantitative evaluation of public policy

outcomes against the targeted aims as well as the perverse effects generated.

Our study provides new quantitative elements in order to contribute to the evaluation of this reform against its objectives to increase production* and productivity*, and the quality of hospital care. More specifically, it involves defining and constructing standardised indicators based on routinely collected hospital data (Data insert) to measure hospital production (aggregate activity), productivity (ratio between production and the resources necessary to this production), quality of care and the potentially perverse effects of T2A. Annual changes in these indicators were studied over a relatively long period, before and after the introduction of T2A (2002-2009). It is a sectorial analysis rather than an evaluation at hospital level, even if the majority of indicators are calculated at individual hospital level. The questions asked are macro-economically focused: Do we produce more or less for each euro spent on the hospital sector since the introduction of T2A? Has the structure of production been modified? How did the quality of the care evolve?

It should, however, be noted that it is impossible on the basis of this analysis alone to establish direct causality between the changes observed and

* To see definition in insert page 2.

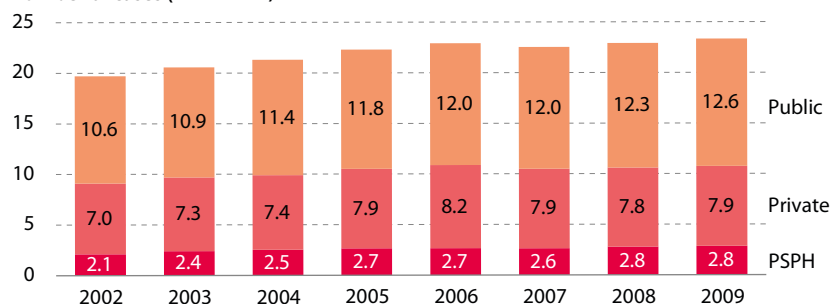
G1

Evolution of hospital stays and sessions between 2002 and 2009

Rate of use (per 100,000 inhabitants)



Number of cases (in millions)



Data: PMSI MCO 2002-2009.

Data available for download.

the introduction of T2A. Numerous reforms introduced over the same time period are also susceptible of having influenced hospitals' behaviour. The aim of the analyses provided here is to propose a methodology exploiting available hospital data to support pertinent longitudinal monitoring and subsequently an impact analysis.

A visible increase in hospital activity between 2002 and 2009

Adjusting hospital activity to cater for the demand for care has been quoted as one of the objectives of the T2A reform (Report to Parliament, 2009). In certain domains, increasing the volume of activity is recommended if care needs are insufficiently covered. On the contrary, increasing the volume of activity is not justified when it concerns the delivery of unnecessary or inappropriate care. In France, the control of hospital expenditures is ensured by a price/volume regulation mechanism (tariffs are lowered according to increase in global activity) that does not account for changes in activity at the hospital level and local population needs. This kind of mechanism can incite hospitals to specialise in relatively standard routine care activities to the detriment of producing more complex care.

The number of hospital stays and sessions (chemotherapy, radiotherapy, and dialyses) increased steadily throughout the period 2002-2009, from 20 million stays and sessions in 2002 to a total of 23 million in 2009; an overall increase of 16% and an average 2% annual growth rate. The number of hospitalisations per inhabitant (rate of use) thus increased by 10% between 2002 and 2009 (Graph 1).

The changes observed in the number of hospital stays and hospital sessions are nevertheless very different. The growth rate for hospital sessions remained constant whether before or after the introduction of T2A: 15% increase between 2002 and 2005, and 15% from 2005 to 2009. On the contrary, the number of hospitalisations increased by almost 7% between 2002 and 2005, before the introduction of T2A, and has remained relatively stable since. This could be interpreted as the result of the impact of macro-economic regulation on global volumes.

Different evolutions in public and private sector

Globally, the distribution of activities between the public and private sectors did not alter significantly over the peri-

od 2002-2009. We nevertheless observe a slight increase in private non-profit hospital (PSPH) activity and a slight decrease in for-profit clinics' activity volume. The distribution of activity according to type of hospitalisation, however, showed differences between the three sectors.

In public hospitals, an increase in the number of stays whatever the type of activity

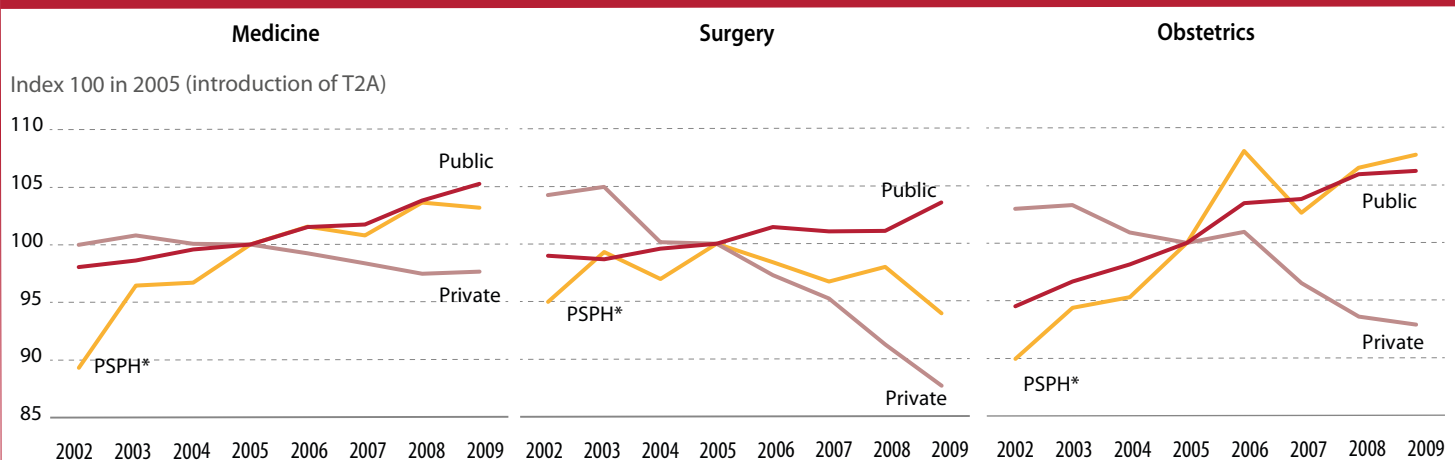
Before the introduction of T2A, we observe a regular increase in full hospitalisations (overnight stays) in all sectors (Graph 2). After 2005, the trend differed according to sector: full hospitalisations in medical, surgical and obstetrics wards continued to increase in the public sector, whereas they decreased in the private for-profit sector.

A decrease in the number of private sector hospitalisations in medicine and obstetrics

The number of hospitalisations in medical wards decreased by 7% and 5% respectively in private-for-profit and non-profit hospitals, between 2005 and 2009. Over this period, obstetric cases also decreased by 13% in private clinics; these appear to have been transferred to public and private non-profit hospitals with 4% and 5% increases in volume respectively.

G2

Evolution in the number of full hospitalisations between 2002 and 2009



* PSPH: Private non-profit hospital.

Number of cases in millions in 2005: **Medicine**. PSPH: 0.3; Private: 0.8; Public: 3.2 / **Surgery**. PSPH: 0.3; Private: 1.3; Public: 1.2 / **Obstetrics**. PSPH: 0.06; Private: 0.2; Public: 0.5.

Data: PMSI MCO 2002-2009.

Data available for download.

These changes do not alter differences in the *case-mix* (severity and patient characteristics) between sectors: private sector activity is essentially surgical (53% of stays) whereas the public sector handles the majority of medical stays (68% of stays) [Table 1].

The increase in the number of outpatient cases in medical wards until 2006 appears to be related to a coding effect

The evolution in the number of outpatient hospitalisations (without an overnight stay) has been fairly similar in each sector with a steady and considerable increase until 2006 followed by a decrease and stabilisation between 2006 and 2009. The decrease in outpatient activity between 2006 and 2007 in all sectors could be linked to the clarification and homogenisation of coding and billing rules for certain very short-stay hospitalisations¹. In 2006, the Department of Health has issued a decree, specifying the activities which cannot be coded as outpatient episodes which were subsequently considered as ambulatory visits and no longer recorded in the Hospital episodes database (PMSI, *Programme de médicalisation des systèmes d'information*). Despite some excess coding until 2006, it appears that public hospitals have significantly increased their outpatient activity over the last few years (over 8% since 2005) gaining some market share from private hospitals. In the private sector, includ-

T Evolution in the total number of hospital stays by type of care (in millions) between 2002 and 2009

	Public			Private-for-profit			Private non-profit		
	2002	2005	2009	2002	2005	2009	2002	2005	2009
Medicine	5.71 69%	6.53 72%	6.38 68%	2.17 40%	2.60 43%	2.43 41%	0.61 56%	0.75 58%	0.72 57%
Surgery	1.79 22%	1.77 20%	2.04 22%	2.94 54%	3.15 52%	3.14 53%	0.40 37%	0.45 35%	0.47 37%
Obstetrics	0.79 10%	0.84 9%	0.87 9%	0.36 7%	0.36 6%	0.31 5%	0.07 7%	0.08 7%	0.09 7%
Total (100%)	8.3	9.0	9.5	5.5	6.1	5.9	1.1	1.3	1.3

Source: PMSI MCO 2002-2009. Data available for download.

ing both for-profit and non-profit hospitals, medical outpatient episodes have slightly decreased in relation to 2005 (Graph 3).

A clear increase in outpatient surgery in all sectors

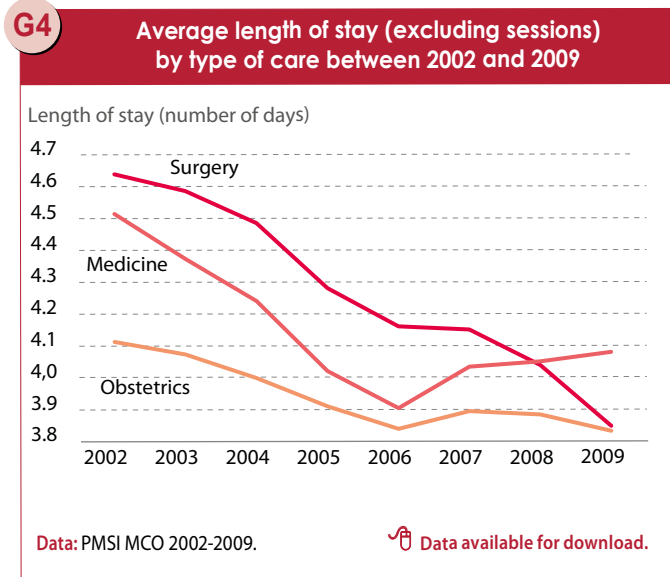
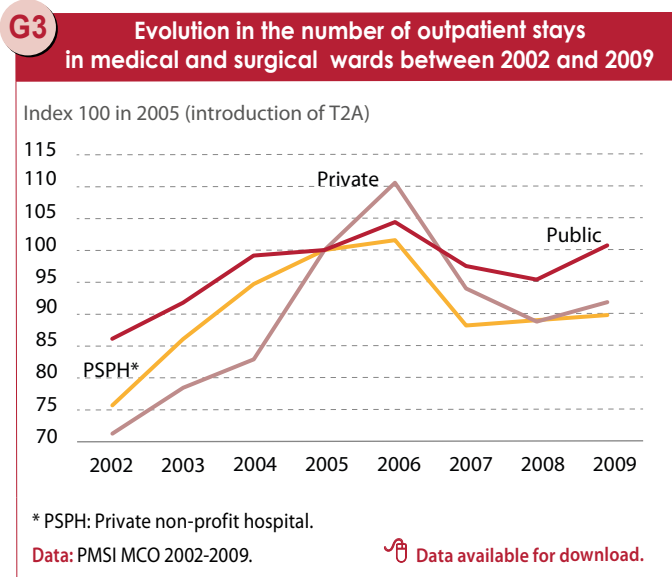
On the contrary, outpatient surgery has increased in all sectors. This increase is considerable in the public sector (60% increase) since the implementation of T2A whereas it has been more moderate (about 20%) in the private-for-profit sector (whose rate of outpatient surgery was already high) and the non-profit sector. Despite these trends, the private sector remains the main producer of outpatient surgery: in 2009, 70% of outpatient surgery was performed by

the private-for-profit sector (62%) and the private non-profit sector (8%) [Or *et al.* 2013].

The reduction in length of stays explained by the development of outpatient surgery

The T2A provides direct incentives to reduce costs and therefore to reduce the length of hospital stays. Hospitals are expected to reduce costs through

¹ DHOS Circular of August 31st 2006 on Diagnosis Related Group (DRG) billing conditions for hospital care in very short stay observation facilities and care lasting less than a day.



eCONTEXT

This research is supported financially by the Public Health Research Institute (IRESP, *Institut de recherche en santé publique*). It supplies quantitative elements for evaluating hospital funding reforms. More complete results and the methods used are presented in the IRDES working paper n°56 (Or *et al.* 2013).

more efficient management (specially by increasing outpatient stays), but an alternative strategy is to send patients home prematurely, from a clinical point of view, or to transfer them to other healthcare structures.

Monitoring average length of stays (ALOS) by type of care shows that the reduction in the ALOS is essentially explained by shorter stays in surgery through the development of outpatient surgery, a trend that had started before the introduction of T2A. On the contrary, the ALOS in obstetrics and medicine, which decreased between 2002 and 2006, has remained stable since 2006 with a slight increase in the length of stays in medicine (Graph 4).

system and their public service mission leave public hospitals little possibility of independently allocating their capacities between the different medical and surgical activities. While private clinics are also subject to authorisations, they have greater decision-making power. These differences have resulted in radically different production strategies between public and private sectors. We thus observe a greater trend towards specialisation in private hospitals as compared with public hospitals. We observe a much lower index of entropy* (index of activity diversification) in the private sector, both in for-profit and non-profit hospitals². During the period from 2002-2009, the gap between public and private hospitals has widened in terms of specialisation (Graph 5). Whereas the index of entropy is stable throughout the whole period in the public sector, it decreased in the private sectors. At macro level, T2A does not appear to have modified diversification/specialisation in the public sector. On the other hand, a trend towards specialisation has been observed over the whole period in the private sectors.

increase in *case-mix* weighted hospital production (over 10% in ISA* points) in relation to the private-for-profit hospitals where we observe, globally, a stagnation of weighted production (Graph 6). In private non-profit hospitals, the trend is similar to that of the public sector, but growth in production was greater before 2005 (+15%), than after (5%).

In all sectors, better activity coding and changes in coding habits (optimisation of co-morbidities) would have an impact on the higher production index. However, the significant increase in the number of ISA points in the public sector can be explained both by the increase in the number of hospital stays (previous section) and by the *case-mix* (full hospitalisation). In the private sector, the increase in the volume of activity has been especially high for outpatient stays. Yet these less complex outpatient stays are allocated fewer ISA points than full hospitalisation stays. While the number of inpatient hospitalisations has decreased in private clinics, the number of ISA points has remained stable overall due to the considerable increase in outpatient stays. On the other hand, the growing gap between the public and private sectors (since 2007)

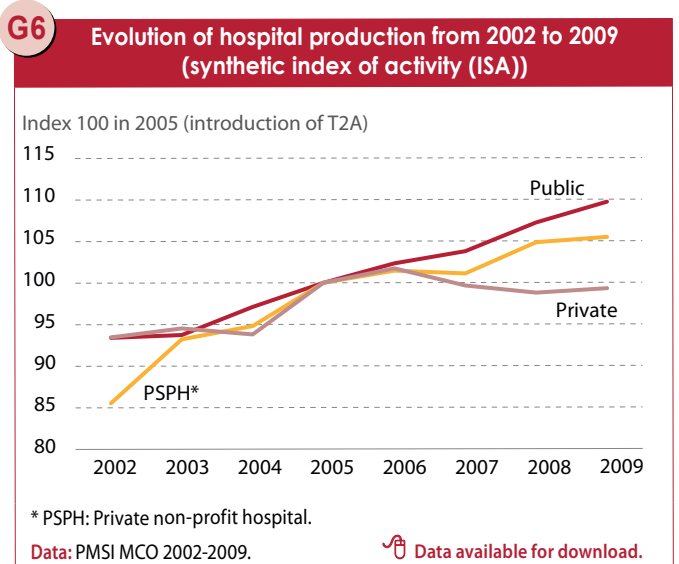
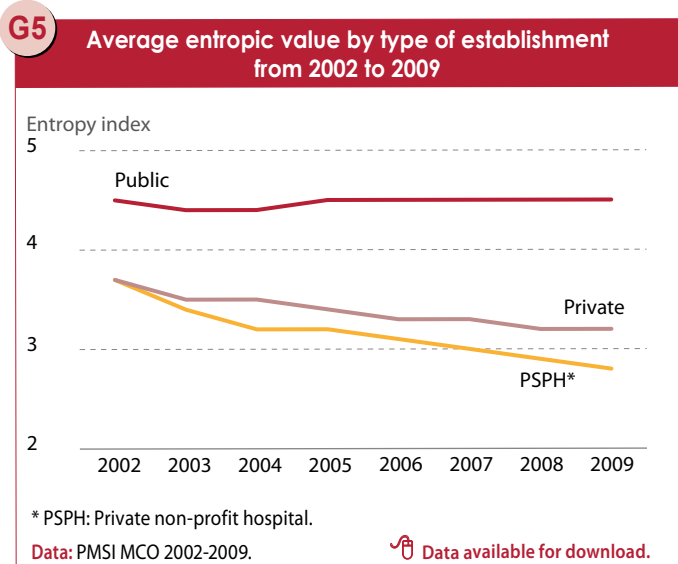
A marked trend towards specialisation in the private sectors

Considerable increase in *case-mix* weighted production in the public sector

Public hospitals have a limited power in defining their scope of activity. The hospital planning and authorisation

Since the introduction of T2A, public hospitals have shown a considerable

² It should be noted that Centres for the Fight against Cancer are included in the category "private non-profit" which explains the lower entropy index for this sector compared to the private-for-profit sector.





Hospital Activity data were taken from the Medical Information Systems Programme (PMSI, *Programme de médicalisation des systèmes d'information*) database concerning short hospital stays in medicine, surgery and obstetrics (MSO) for the period 2002 to 2009. In the databases used (supplied by the DREES), stays were grouped together in version 9 (V9) with the exception of the years 2002 and 2009. To calculate the production in ISA points for the whole period, it was necessary to create correspondence algorithms between versions 8 and 9 for 2002 and between versions 9 and 10 for 2009. Hospital resources data were taken from different sources: Ecosanté, SAE (*Statistique annuelle des établissements de santé*), DREES (*Direction de la recherche, des études, de l'évaluation et des statistiques*) and ATIH (*Agence technique de l'information sur l'hospitalisation*).

could indicate different *case-mix* trends between the two sectors.

Productivity is improving in the public sector since the implementation of T2A

As a whole, public hospitals have steadily increased their productivity* since the introduction of T2A. Increased production* has been accompanied by a reduction in human resources* (excepting doctors) and capital. This indicates increased productivity in production factors measured in volume. However, the increase in hospital expenditures has been more rapid than the increase in production in all sectors. This could suggest that staff-related expenditures have continued to increase for structural reasons (social contributions, 35 hours etc.). It is also possible that expenditures have risen due to intermediate consumptions such as drugs, the cost of medical equipment and the more intense use of new medical technologies.

As to the private-for-profit sector on the other hand, the productivity of public health insurance expenditure (the relationship between weighted production

growth and growth in health insurance payments) has decreased since the implementation of T2A. This can partially be explained by the changes in activity (*case-mix*).

Quality of care indicators need to be monitored

The T2A system can present an intrinsic risk regarding the quality of care as it creates direct pressure on hospitals to reduce the length and cost of hospital stays without taking therapeutic outcomes into account. 30 day mortality and readmission rates after care or surgery are outcome indicators regularly retained in the literature but are not monitored in France.

Lower hospital mortality rates at 30 days...

30 days* mortality rates for the three types of care (colorectal cancer surgery, acute myocardial infarction and strokes) have decreased over the period concerned. This decrease in mortality rates, that had begun prior to the introduction of T2A, maintained the same rhythm for acute myocardial infarctions and strokes whereas the decrease was more significant from 2007 for colorectal surgery. The overall results are reassuring but it is impossible to isolate the impact of T2A on these trends in relation to other

hospital reforms (such as the introduction of volume thresholds for heart surgery and oncology) [Graph 7].

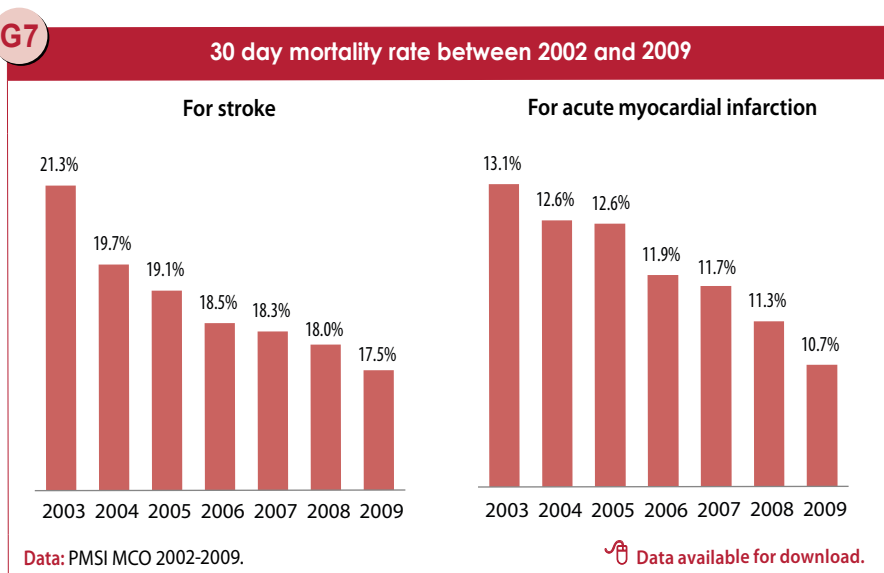
... but an increase in the number of 30 day readmissions

We observe a clear increase in the rate of 30-day readmissions* in the last years of the period concerned (2007-2009), notably for medical cases regarding strokes and myocardial infarction but also colon cancer surgery and hip surgery. This trend towards an increase in readmissions, observed for several types of care defined according to distinct medical criteria, is alarming. It should be subject to regular monitoring and deeper analysis (Graph 8).

No evidence of low risk patient selection...

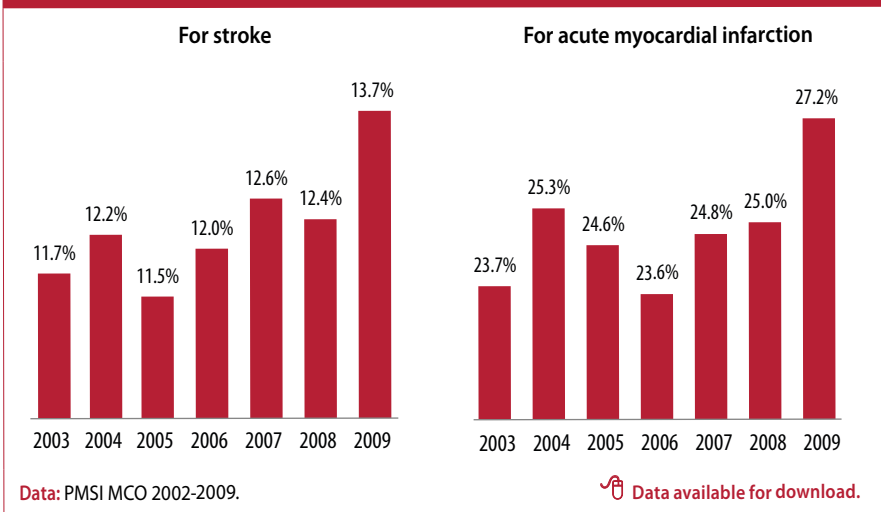
The T2A can also give rise to undesirable provider behaviours. Two perverse effects, well described in the literature, are the selection of low-risk patients and supplier induced demand. Different patient-selection strategies are possible; the specialisation in relatively standard and programmed care is one method. Furthermore, when the tariffs are not adjusted to compensate for complex cases within a DRG, hospitals can reduce the intensity and/or length of care for more complex patients.

We tested the existence of eventual strategies to reduce the resources dedicated



G8

30 day readmission rate between 2002 and 2009



to patients representing the highest care costs (the oldest, or sickest patients) by comparing changes in the length of hospital stays for different patient profiles (oldest and more than 4 associated diagnoses against younger with fewer co-morbidities) for the same type of care. We emit the hypothesis that in order to optimise payments per stay (cost of stay covered by the DGS tariff), the more elderly patients and/or those with the most co-morbidities are not refused but discharged from hospital in ever shorter timespans and maybe in an unstable state. The comparison of changes in the length hospital stays among the more elderly patients with a higher number of co-morbidities does not allow us to confirm this hypothesis in hospitals under the T2A system. As expected, the aver-

age length of stay for more elderly/sick patients is longer than for other patients. We observe shorter lengths of stay for all patients undergoing the three types of care, but the average length of stay seems to decrease at the same rate for all patients. Overall, our results do not suggest any difference in the modality of care according to gravity.

... but possible hospital induced demand for care that is poorly or not at all justified

In the literature on the variability of medical hospital practices, it has been demonstrated that hospitals can induce demand for certain interventions where there is no medical consensus on good medical practice and/or when it poses

no threat to the patient's life (Skinner, 2012).

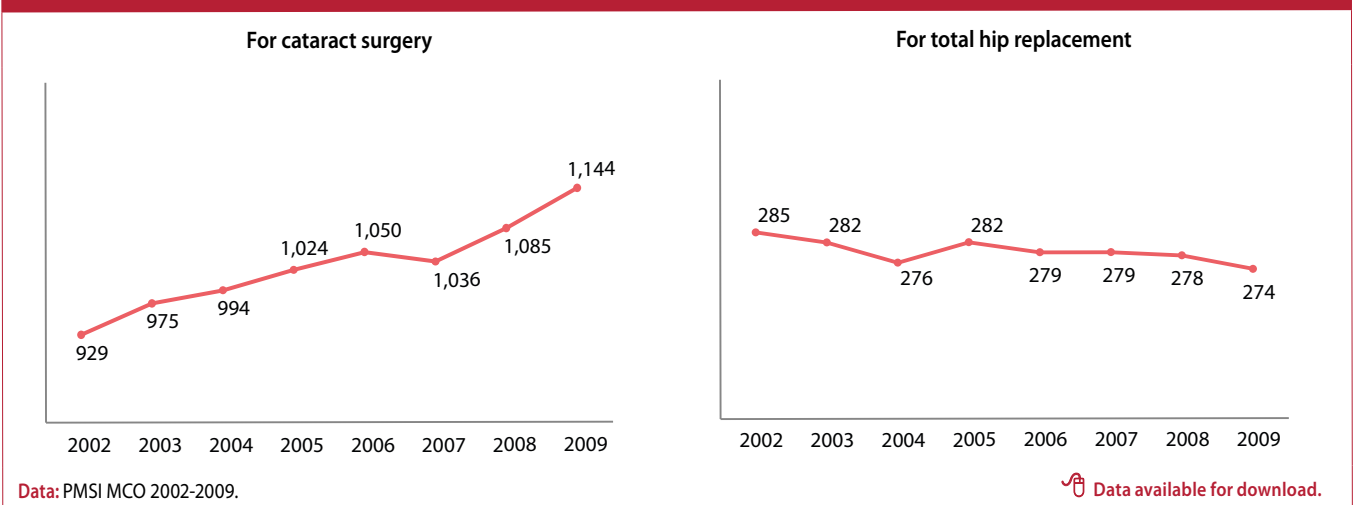
We compared the evolution in the rate of use of two minor interventions (cataract surgery and endoscopy) and an intervention for which the indications are subject to debate (prostatectomy) compared to the rate of use of hip surgery (total hip replacement), a heavy intervention the indications for which seem easier to define (more difficult to induce). The rates of use have been standardised to neutralise demographic changes. As expected, we note that the number of hospital stays for hip surgery per 100,000 inhabitants remained stable between 2002 and 2009. There is no observable difference before or after the introduction of T2A. The standardised rate for cataract surgery, on the other hand, has steadily increased since 2002 with a total increase of 23% during this period (Graph 9). The rate of prostatectomies and the number of endoscopies per inhabitant have also increased significantly even if the rate of increase slowed down in 2007 and 2008, with the introduction of guidelines concerning these procedures.

A first quantitative approach...

This study presents a first quantitative approach to evaluate the French T2A system using a series of indicators to establish changes that occurred before and after the introduction of the reform over the period 2002-2009.

G9

Standardised rate per 100,000 inhabitants between 2002 and 2009



Our results show that in public hospitals, the volume of activity (number of stays) and hospital production (*case-mix* weighted stays) increased steadily between 2002 and 2009 whatever the type of activity, with a more marked increase for stays in surgery. In private-for-profit hospitals, a marked increase in hospital sessions and outpatient surgery has been observed in parallel with a decrease in the number of full hospitalisations in obstetrics and medicine. Overall, we note a trend towards an increase in productivity (relationship between production and resources used) in the public sector since 2004, whereas in the private-for-profit sector we observe a change in activity (*case-mix*) rather than a marked increase in productivity. In addition, the rate of readmission at 30 days* for the main cardiovascular and oncology treatments have increased since the introduction of T2A. The indicators used in this study did not reveal a discrimination strategy aimed at older patients with multiple disorders on the part of hospitals. The considerable increase in standardised

rates for certain interventions/medical acts however suggests the possibility of supplier induced demand for hospital care that is poorly justified.

Our analyses have limitations due to the imperfection of certain hospital data and the quality of coding during the period studied. Also, we measure only a part of hospital production as external consultations and visits to emergency without hospitalisation were not taken into account as they are part of hospital activity database. The analysis of hospital production and its evolution was also faced with numerous difficulties related to the lack of data on costs for private-for-profit hospitals. In fact, these hospitals have only been represented in the national cost study sample fairly recently but their numbers are limited.

... contributes to improving knowledge and transparency regarding the hospital sector

These first sectorial analyses are aimed at establishing the basis for hospital poli-

cy evaluation but are insufficient as such to specifically measure the impact of T2A. To do that, one would need to take the influence of contextual factors into account (as well as other reforms that may also have influenced the results) using longitudinal data models at individual hospital level. The quantitative approach proposed here nevertheless enables a description of trends within the hospital sector during the period of T2A implementation (before and after) in a systematic and coherent manner. In this respect, our research contributes to improving knowledge and transparency regarding the hospital sector in France. The type of indicator used should be enriched by others, routinely produced and easily accessible to hospitals and regional health agencies, enabling them to compare providers. Monitoring hospital activity and quality at the provider/hospital level is also necessary in order to verify the pertinence and suitability of care at local level and set up individualised objectives regarding volume of activity and care quality. ♦

FOR FURTHER INFORMATION

- Or Z., Bonastre J., Journeau F., Nestrigue C. (2013). « Activité, productivité et qualité des soins des hôpitaux avant et après la T2A », Document de travail de l'Irdes n° 56, avril.
- Cots F., Chiarello P., Salvador X., Castells X., Quentin W. (2011). "DRG-based Hospital Payment: Intended and Unintended Consequences" in *Diagnosis-Related Groups in Europe*. European Observatory on Health Systems and Policies series. Open University Press.
- Ellis R.P., McGuire T.G. (1996). "Hospital Response to Prospective Payment: Moral Hazard, Selection and Practice Style Effects". *Journal of Health Economics*, 15: 257- 277.
- OCDE (2012). Health Data 2012, base de données de l'OCDE sur la santé.
- Rapport au Parlement sur la tarification à l'activité (2009). http://www.sante.gouv.fr/IMG/pdf/Rapport_T2A_2009.pdf
- Shleifer A. (1985). "A Theory of Yardstick Competition", *Rand journal of Economics*, vol. 16(3), 320-27.
- Skinner J. (2012). "Causes and Consequences of Regional Variations in Health Care", *Handbook of Health Economics*, Volume 2.

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Director of the publication: Yann Bourgueil • Technical senior editor: Anne Evans • Associate editor: Anna Marek • Reviewers: Julien Mousquès, Camille Regaert •
Translator: Véronique Dandeker • Copy Editing: Anna Marek • Layout compositor: Damien LeTorrec • ISSN: 1283-4769.