

# Emergency physician workload modeling

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## ABSTRACT

**Background:** A variety of models are used by hospitals, provincial governments, and departments of emergency medicine to “predict” the number of physician hours of coverage necessary to staff emergency departments. These models have arisen to meet specific requirements—some for the purpose of determining hourly rates of compensation, others to determine the amount of funding that will be provided to “purchase” physician coverage, and others to determine the number of hours of coverage necessary to maintain patient waits within “acceptable” limits. All such models have their strengths and weaknesses and have been criticized as not reflecting the “real” needs of any given department.

**Objective:** In the article that follows, a review of existing models is presented, annotating their strengths and weaknesses to derive the characteristics of an “ideal” workload model.

**Conclusion:** None of the models currently used to measure emergency department workload can be relied on to accurately predict the number of staffed hours necessary. Models that may achieve this objective are suggested.

## RÉSUMÉ

**Contexte:** Les hôpitaux, les gouvernements provinciaux, et les services de médecine d’urgence ont souvent recours à des modèles de planification pour «prévoir» le nombre d’heures de présence médicale afin de doter les services d’urgence de personnel suffisant. Ces modèles ont été conçus pour répondre à certaines fins, par exemple, déterminer les taux horaires de rémunération, le financement nécessaire à l’«achat» d’heures de présence médicale, ou encore le nombre d’heures de service nécessaires au maintien d’une attente «acceptable» des patients. Ces modèles comportent tous leurs forces et leurs faiblesses et font l’objet de critiques quant à leur manque de reflet des besoins «réels» des services, quels qu’ils soient.

**Objectif:** Nous passerons en revue, dans le présent article, des modèles existants de planification et ferons ressortir

leurs forces et leurs faiblesses afin de dégager les caractéristiques d’un modèle «idéal» de charge de travail.

**Conclusions:** Aucun des modèles actuellement utilisés pour mesurer la charge de travail dans les services d’urgence ne permet de prévoir avec précision le nombre d’heures nécessitant une dotation suffisante en personnel. Nous suggérons certains modèles qui pourraient répondre à cet objectif.

**Keywords:** emergency, modeling, physician, workload

Increasingly, emergency medicine providers and leaders have expressed concern about the validity of the Murray formula,<sup>1</sup> derived from visit volume and Canadian Triage and Acuity Scale (CTAS) scores, as the basis of a model to determine optimal emergency department (ED) physician hours of coverage. Concerns focus primarily on the fact that CTAS scores do not consistently correlate with patient complexity, the need for care, and the real-time use of emergency physician human resources. Other concerns include the focus on the presenting complaint, rather than the amount of care that may be required, and the omission of the following:

- Emergency physician time and energy required to manage “held” or admitted patients
- Physician time spent on administrative activity while assigned to clinical duties
- Demands of teaching and research
- Time required for telephone consultation
- Complexity of patients presenting to academic health science centres, either primarily or in transfer
- Patient demographics that may portend greater workloads
- Concern that CTAS scores may lack interinstitutional or interrater reliability

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In this article, a review and criticism of existing emergency physician workload models is presented, followed by a “new” model that addresses the concerns with existing models.

## **METHODS**

*Medline* and *PubMed* searches using the phrases “emergency physician workload,” “emergency department workload,” “emergency physician compensation,” and “emergency physician payment models” were conducted. The articles were reviewed by the author, and only those directly commenting specifically on workload measurement were considered for review. Few articles comment specifically on workload or workload measurement (as opposed to compensation), and none compare them to each other. None described an “ideal” model.

## **SUMMARY OF THE LITERATURE**

Workload models should have the capacity to accurately determine the “workload” in a given department (i.e., the number of hours of service required to provide the necessary tasks). Workload calculations are useful in determining the cost of physician activities but not the rate of compensation per hour (a “compensation” model).

The perceived weaknesses in existing workload models include the following:

- No model includes break times (for lunch, coffee, etc.).
- There is a failure to consider surges in activity—predictable or not. Predictable surges can include those experienced during holidays, when family physicians offices may be closed. Other than the predictable repeated variation in volumes, surges cannot be easily accommodated by any of the workload models.<sup>2,3</sup>
- There is a lack of consistency in addressing the need for a second call physician.
- They are not linked to quality or outcome measures. The only exception is the dynamic model for physician staffing recently introduced in British Columbia. This model is based on ensuring that the interval from patient registration to first physician encounter is 1 hour or less, which can be construed as one measure of quality.<sup>4</sup>

When considering workload models, the following factors should be included:

- Cost
- Ease of implementation
- Validity
- Literature support
- Flexibility
- Alignment of incentives with objectives

The fee-for-service model provides an indirect measure of workload. Detailed billing information gleaned from such a model could measure the number of patients seen and the procedures and interventions conducted.

The Murray model is well entrenched in Canada. It was developed in Ontario and uses mathematical formulae to calculate the number of minutes necessary to provide care to patients of each CTAS category. The total number of minutes of coverage necessary to provide the care needs of the treated population is calculated. Adjustments are made in recognition of the fact that overnight seamless coverage is necessary, even if overnight visit volumes are not sufficient to meet income expectations. It remains at the core of Ontario’s alternative fee arrangements<sup>5</sup> and has been confirmed in studies as a predictor of the actual time required for the doctor-patient interaction.<sup>6</sup>

More recently, however, providers feel that CTAS categorization does not necessarily correlate with complexity or the need for care and therefore might be a poor predictor of the emergency physician time required for any given patient encounter. For instance, the elderly have been found to be disproportionately large users of EDs, often requiring considerable time and energy to plan for a safe return to the community.<sup>7</sup> CTAS categorization does not predict this “need for care” because it is based on acuity of illness, not on the resources required for care. Whereas some studies have attested to the interrater reliability in both paper and real-time exercises,<sup>8</sup> others have demonstrated marked differences in the triage categories assigned to matched patients.<sup>9,10</sup> Some organizations have observed and tried to cope with both “up” and “down” triage.<sup>11</sup> Other factors not considered include the emergency physician’s responsibility for teaching, research, and management of admitted patients lodged in the ED. The formula does not take into consideration time for consultations provided to community physicians. Finally, the model does not capture other important

ED activities, such as procedures and ad hoc administrative activity.

This dynamic model for physician staffing was recently implemented in British Columbia.<sup>4</sup> The model is designed to provide sufficient medical staffing to ensure medical attention within an hour of registration for 90% of patients. The model can be in any size or type of hospital and seems to balance the concerns of efficiency and cost. It is sensitive to baseline variation in any individual department's visit volume and will capture predictable or repeated surges in activity.

It is not a workload model, however, but a model designed to achieve a target wait time. The model requires hospital-specific data collection and analysis to develop the workload/service delivery model for each organization. It requires information technology support that is currently not available in many EDs and works optimally if all EDs in a province report the same data elements in the same system. Thus, in most provinces, it would require investment in new technology and time for data acquisition, development, implementation, and training. Annual review is necessary and can result in adjustment of funded worked hours, with the attendant potential for "pushback." Finally, this model reflects wait time, which may not directly correlate with physician workload.

Innes and colleagues published an observational study in which the time physicians spent with patients was measured by a research assistant during 31 day, evening, night, and weekend shifts.<sup>12</sup> The data gathered indicated the average number of minutes physicians spent with patients by triage category and the amount of time spent on specific tasks. Presumed predictors of the amount of physician time necessary to treat patients (e.g., patient age, mode of arrival, Glasgow Coma Scale (GCS), comorbidities) were recorded. The strongest predictor variables were a procedure required, triage level, arrival by ambulance, GCS, age, comorbidity (any), and number of previous visits. The study could, in theory, be used to determine the number of minutes of physician time necessary to staff a given department based on its CTAS profile. The study did not include teaching as one of its measured time requirements but did estimate that an additional 20% of physician time was used for this activity.

The study reflected the time requirements in a department staffed with highly skilled and experienced providers and the efficiencies gained in treating

a high volume of unique populations, for instance, those with inner-city health issues. These efficiencies, however, have not necessarily been gained in most other hospitals, and external validity remains to be determined.

The Predictors of Workload in the Emergency Room (POWER) Study was conducted in Canada in multiple hospitals in an array of locations (urban, semiurban, and rural).<sup>13</sup> The methodology included real-time measurements done by research assistants who evaluated physician time 7 days a week, 24 hours a day.

The results indicate that the time taken by physicians with patients of similar CTAS categories varies between academic and rural sites. It is informative to compare the time assigned to patients of each CTAS triage category in the aforementioned models. This comparison is contained in Table 1.

The "fixed ratio" model to predict emergency physician workload is used by the American Academy of Emergency Medicine and the American College of Emergency Physicians.<sup>14</sup> The numbers cited as "ideal" range from 1.8 to 5 patients per physician hour. The variables include presence or absence of teaching, whether the department has a fast-track area, and whether the hospital is publicly or privately operated and funded. There is no evidence to support the validity of these suggested times, which reflect only the experience of those groups that have chosen to retrospectively calculate their average time per patient.

A variety of nursing workload models (e.g., Grasp, Medicus)<sup>15,16</sup> are well accepted in the nursing industry and have been validated. Some have been specifically adapted to the ED. They are tailored to capture interventions (such as starting intravenous infusions), which ensures that all elements related to workload are captured. Neither tool has been validated for medical application and would need a period of

**Table 1. Time derived per patient by model**

CTAS	Murray	POWER	St. Paul's Hospital
1	75.6	73.6	40.2
2	41.4	38.9	25.3
3	25.2	26.3	21.8
4	12.6	15.0	15.6
5	7.8	10.9	15.2
Average	20.6	22.0	19.2

CTAS = Canadian Triage and Acuity Scale; POWER = Predictors of Workload in the Emergency Room.

development to customize it for physician use and subsequent validation.

A comparison of all of the above-described models is provided in Table 2.

**DISCUSSION**

Although seeking to define with a workload model the number of hours of service to be provided to meet the “total” needs of a given department (as opposed to the hourly income of emergency physicians) is desirable, other outcomes also need to be considered. All parties have an interest in improving the timeliness of care, maximizing the “comprehensiveness” of care, and ensuring the quality of outcomes. Thus, a workload model must not interfere with these other objectives and, ideally, should enhance consumer and provider satisfaction.

The workload of an emergency physician includes clinical, academic, and institutional activities.

The clinical workload reflects the need to evaluate, resuscitate, stabilize, and treat patients. Included in this component of workload are the conduct of procedures and arranging for consultation and admission where appropriate. Time for consultations should also be included in the workload model. EDs could be asked to report the number of consultations conducted on a quarterly or annual basis, and a sum of money should be added to the department’s allocation of funds to purchase more worked hours.

Emergency physicians taking responsibility for writing admission histories, physical examinations, and orders are outside core ED practice and should be counted separately. EDs should be asked to report the number of admissions managed on a quarterly or

annual basis, along with the average duration of that care, allowing again for a sum of money to be added to the department’s allocation of funds. Any clinical activity conducted outside the ED that increases workload (e.g., attending in-patient emergencies) should be funded through another envelope.

The use of extended periods of observation and treatment for a variety of clinical conditions has been shown to decrease the rate of hospital admissions and not adversely affect quality. Factors such as age, comorbidity, and mode of arrival have been shown to have an impact on workload. These factors are commonly encountered in patients kept in the ED for extended periods, often in a clinical decision unit (CDU). Measurement and reimbursement specifically focused on patients requiring care in the extended diagnostic or clinical decision unit can be used as a surrogate marker of workload for these patients. For workload measurement purposes, the workload of each patient should be reflected by the average workload of all patients in the CDU.

In the Ontario pilot model, a comprehensive daily fee was developed to compensate EDs for the care of patients in a CDU. Each department was to track and report on a quarterly basis the number of patients treated in its CDU (or equivalent).

In teaching hospitals, there is a teaching workload. In general, it is agreed that undergraduate trainees increase workload, whereas senior postgraduate trainees may decrease it because of their capacity for independent decision making.<sup>17</sup> In Nova Scotia, academic health science centres have been provided with an additional 13% in revenue over their calculated workload to account for teaching activity.

**Table 2. Comparison of workload models**

	FFS	Murray	DMPS	St. Paul’s Hospital	POWER	Fixed ratio	Nursing workload
Cost of acquisition/ implementation	Low	Medium	High	Low	Low	Low	High
Ease of implementation	High	Medium	Medium	High	High	High	Low
Validated?	High	High	Medium	Low (not used yet)	Low (not used yet)	Low	High
Literature support	Yes	Yes	No	Yes	Yes	Variable	Yes
Flexible across sites	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aligns incentives/ objectives	No	Yes	Yes	Yes	Yes	No	Yes

DMPS = Dynamic Model for Physician Staffing; FFS = fee for service; POWER = Predictors of Workload in the Emergency Room.



All hospitals taking roles in education should have their allocated number of work hours increased in proportion to their educational activity. Hospitals could calculate the number of learner days in their EDs and receive an incremental workload allocation based on the ratio of teaching days in their departments to the province's academic health science centres.

An "institutional" workload is undertaken in every ED. Institutional workload can be conceptualized as activities related to managing patient care processes in the ED, the interface of the clinical processes of the ED with the rest of the hospital, and extramural functions such as poison control or base hospital functions (if not already funded). This may include negotiating with in-patient units for the transfer of patients, discussion with consultants regarding the need for consultation and/or the timeliness with which it is delivered, and responding to the overcrowding issue.

There are two philosophical approaches to addressing this workload. One could assume that this is an "institutional" issue and should not be factored into calculations of ED workload. This would, however, necessitate that other individuals in the organization assume these responsibilities. A second approach would be to integrate an "institutional" workload factor into the calculated number of hours of service necessary in the ED. Measuring the actual workload required would be difficult and require its own modeling because it would vary depending on institutional efficiencies over time. Either way, a workload model should reflect the need for time to deal with administrative processes.

In defining workload, it is evident that not all tasks need to be undertaken by physicians. This suggests an opportunity for departments to identify the optimal workload distribution among physicians, nurses, and midlevel providers.<sup>18</sup>

In summary, the following workload model is suggested for determining required emergency physician hours of service:

- Use the POWER or CTAS/Murray formulas adjusted for CTAS 4 and 5 visits to determine base staffing requirements
- Add an incremental factor for ad hoc administrative duties
- Add an incremental factor for teaching in departments not currently reimbursed for teaching
- Add an incremental amount for consultations provided by emergency physicians

- Add an incremental amount for patients treated in a CDU or similar model
- Add an incremental amount for admission assessments

Ideally, the workload measurement model should measure the total workload in the department, irrespective of the chosen care provider. A workload model that encourages and allows departments to use the most appropriate care provider would be ideal. The selected model should not shift the imperative for dealing with issues such as overcrowding, consultant response times, or delays in access to in-patient beds to the ED, nor should it impact on outcomes or the quality of care.

### LIMITATIONS

This article reviews the workload measurement schemes in use in Canada and the United States. The review is limited by the sparse number of publications on the issue and the fact that many of the criticisms of existing models are "anecdotal" in nature and have not been validated in the literature. Additionally, the modifications suggested to address the shortcomings have not been tested or validated and reflect opinion and "intuitive" responses to the perceived deficiencies. Although criticism of current models abounds, there is no evidence that workload models are negatively affecting care but much concern that this is, indeed, the case.

The proposed short-term restructuring of the workload model also relies on using the dollars gained by adding reimbursement for "worked activities" to a department's budget as a means of purchasing additional worked hours but is not, in the pure sense, a true "workload measurement" tool. With the benefit of an appropriate information technology tool, it should be possible to measure actual workload and design a funding model that recognizes true workload.

### CONCLUSION

No existing model accurately measures ED workload. As no single existing model has been demonstrated to be "perfect" and there are concerns with each model, it is suggested that a "hybrid" model be adopted. The base component of the hybrid model could either be a refinement of the Murray formula or the POWER study. A province could continue with the current CTAS/Murray formula but allocate the number of

minutes found in the POWER study to be appropriate for CTAS level 4 and 5 patients.

**Competing interests:** Dr. Dubinsky is an associate director of Hay Group Health Care Consulting and received professional fees from Doctors Nova Scotia for the development of a workload model for that organization.

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