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Abstract:

This work evaluates policy recommendations on medical error reporting systems presented in, ***To err is human****, a report published by the Institute of Medicine. Here mandatory reporting should be applied for adverse events, while voluntary reporting is recommended for near misses. This analysis shows that an error reporting scheme of this type is not an optimal one since both near misses and adverse events may remain unreported. This work makes evident that penalising health care decision makers for not reporting errors, independent of error category, is crucial for reaching the first-best solution.*

The Institute of Medicine report (IOM, 2000) on the quality of health care drew considerable attention and awakened the interest in medical error prevention. The report recommended a national goal of reducing the number of medical errors by 50 percent over 5 years.[1] To that end, IOM outlined an approach that included actions to; i) enhance the knowledge base about safety, ii) raise standards for improvements in safety through the actions of oversight organisations, and iii) identify and learn from medical errors through both mandatory and voluntary reporting systems.[2] The IOM report is part of a new perspective on error prevention (*the new patient safety movement*) that recommends disclosure, openness and transparency and questions the adequacy of current malpractice systems (Studdert et al. 2004, Sage, 2003, Bovbjerg et al 2001).[3] Information on medical errors is considered valuable since regulatory bodies and health-care institutions themselves could systematically report, register and analyse such data and translate them into useful information to reduce the future frequency and severity of errors.[4] National databases are perceived particularly useful in their ability to detect unusual events and identify emerging problems.[5] The value of information is not associated with adverse events, only, but also near misses. Knowledge about near misses is useful for predicting future adverse events and providing regulators with the opportunity to respond to them to avoid such costly events. DH (2000) perceives near misses as free lessons.

The emphasis on learning benefits together with the current underreporting of medical errors has led to a discussion of the adequacy of reporting systems.[6] Reporting systems vary in scope, in type

[1] The IOM report is also discussed in Brennan et al., (2000).
[2] The recommendations were later evaluated by the Quality Interagency Coordination Task Force (QuIC) that fully endorsed the IOM's call for action and developed a strategy that builds on their recommendations and in some cases goes beyond them (QuIC, 2000).
[3] A wide range of fundamental policy reforms to malpractice systems are suggested including new mechanisms for solving disputes, no-fault systems, change in legal liability and a call for more system-orientated approaches (Studdert and Brennan, 2001).
[4] By medical error is meant an injury or illness caused by medical management rather than by the underlying disease or condition of the patient (adverse event) or an event that could have resulted in an injury or illness (near miss).
[5] See e.g. the special issue of the British Medical Journal (320; 2000), DH (2000) and Runciman and Moller (2001) for more on the value of error information.
[6] Cullen et al., (1995) finds, for example, that errors are underreported by a factor of 10. Barach and Small (2000) refers to literature for which the estimated underreporting of adverse events range between 50%-96%.

of information collected, how information is analysed, in confidentiality provisions, and how feedback to reporters is fashioned.[7] IOM (2000) defines mandatory reporting as systems that hold providers accountable for their performance, while voluntary reporting focuses on patient safety improvement by the provision of information. Mandatory reporting programs are operated by state regulatory programs that have the authority to investigate specific cases and to issue penalties and fines for wrong-doing. According to IOM these systems; i) provide the public with a minimum level of protection due to investigations and follow-up actions, ii) provide incentives to improve patient safety and, iii) require all organisations to make some level of investments in patient safety. Voluntary reporting programs identify errors and remedy vulnerabilities in systems before the occurrences of harm and there are no penalties observed around specific cases.[8]

IOM (2000) identifies a need both for mandatory and voluntary reporting systems in connection with medical errors and recommends a reporting hierarchy sorting errors into two categories; i) errors that result in serious injury or death (adverse events) and ii) lesser injuries or noninjurius events (near misses). Mandatory reporting systems should be applied for serious adverse events (involve liability), while near misses should be subject to voluntary reporting.[9,10] Hence, a system for which medical errors are treated differently conditioned upon the category of error is proposed.[11,12] The IOM proposal raises some interesting questions as concerns optimal incentives in health care.[13] Reporting incentives and the value of learning are perspectives that have been ignored in the health economic literature. In this paper an evaluation of the IOM incentive system is undertaken.

[7] Reporting systems suffer from underreporting and the degree is believed to depend on factors such as; whether the programme is mandatory or voluntary, confidentiality or not, reporter perceptions, and the degree of feedback provided to reporters.
[8] IOM identifies legal constraints on protecting data submitted to voluntary reporting systems since health care organisations are concerned that sharing information about errors will expose them to litigation.
[9] The same recommendations are endorsed by QuIC (2000). DH (2000) recommends a mandatory reporting scheme for adverse events and specified near misses, while Cohen (2000) and IMSP (1999) favour voluntary reporting systems.
[10] A possible explanation for the distinction between the two error categories is that adverse events are easier to identify and harder to conceal. Public disclosure combined with investigations and the possibility of being held accountable is believed to induce physicians to lie low given the occurrence of near misses.
[11] However, it is somewhat unclear whether IOM, by mandatory reporting, allows for the possibility to penalise decision-makers for failing to report (see also section 3).
[12] Such a system is not obvious from a judicial point of view since the question of liability or wrong-doing need not be correlated with the degree of patient injury. Brennan et al., (1996) find that the primary determinant of whether an injury will receive compensation is the extent of injury, not the extent of fault.
[13] IOM (2000) does not discuss how the policy proposal relates to current malpractice systems.

This is done by applying an analytical model, where incentives, both to prevent errors from occurring (deterrence) and to report about such incidents once they occur, are studied. An important feature of the model is that the occurrence of medical errors and their category (adverse events and near miss) is private information to health care workers. The model is one with moral hazard, risk neutral agents, and a noisy negligence rule.[14] Only efficiency issues are considered which implies that distributive (patient compensation) considerations are ignored.[15] The paper is organised as follows. In section 1, a general model is presented for which penalties are conditioned on the category of error and a first-best penalty scheme is derived. Section 2 analyses the IOM policy proposal. The last section concludes.

1. A model of error prevention and learning.

The analysis concerns the relationship between a regulator and health care workers. The model borrows from the literature on hidden information and mechanism design formerly applied to analyse tax reporting incentives and environmental compliance (see Kaplow and Shavell (1994) and the references therein).[16] The regulator is concerned both with accountability (deterrence) and informational gains. The physician is exposed to the risk of committing medical errors and undertakes a two-step decision process.[17] First, they decide on how much to invest in costly preventive activities to avoid the occurrences of errors. Second, given the occurrence of an error, they decide on whether to report about an incidence or not. Two types of penalties (fines) are introduced for each error category (adverse events, AE, and near misses, NM).[18] First, a penalty, t_i, in the following denoted as *the accountability penalty*, is imposed if the physician is held liable for a medical error, where $i = AE, NM$.[19] This penalty is the same independent of how the incident was revealed to the regulator.

[14] This assumption implies that the expected liability risk is negatively correlated to the care level. There is nothing like a due care level that ensures ex-ante with certainty that negligent errors can be avoided and that the provider will not be held liable.
[15] Patient compensation can be achieved by liability (malpractice systems) or by no-fault systems (administrative systems).
[16] The issue of medical errors introduce additional dimensions since the objective of regulation represents two social externalities – patient injuries (a negative one) and learning benefits (a positive one).
[17] The observed tendency to blame individuals, rather than placing responsibility on institutions, is challenged in several works (see Reason, 2000 and Reinertsen, 2000). This work is not concerned with what level to put the blame. In the text we denote the responsible agent(s) as physicians.
[18] Here we follow the literature on optimal deterrence by treating fines as costless transfers (redistributed).
[19] In US malpractice law near misses can not be litigated.

Second, the regulator may impose a penalty, s_i (*non-report penalty*), for those who fail to report about an incidence and are detected, where $i = AE, NM.$ Consequently, an individual choosing not to self-report, given error category *i*, but is detected and held liable, is penalised by $t_i + s_i$, while a self-reporting individual being held liable faces the penalty t_i, only.[20]

In the following *p(e)* denotes the probability of an error to occur, where *e* is expenditures invested in reducing this probability (preventive effort) and *p(e)* is continuous, twice differentiable, and a strictly decreasing function in effort; $p_e^{'} < 0, p_{ee}^{''} > 0$. Hence, effort is here assumed to influence the probability of errors only, and not the distribution of outcomes.[21] The value of *e* is unobservable (or not verifiable) for the regulator. At the end of the first period, for a given *e*, physicians observe privately whether an error has occurred or not. Given an incidence, physicians face two possible options - whether to report about the incidence to the regulator (self-report), or to lie low (non-report), but risk being discovered by the patient, the patient family, colleagues, or medical audits. The occurrence of an error is private information for physicians and the incident itself provides them with information on what category of error that has occurred. The two error categories, adverse events and near misses, differ with respect to social (patient) costs implications; D_{AE} and D_{NM}, where $D_{AE} > D_{NM} = 0$. These costs include patient injury and discomfort as well as treatment costs due to rehabilitation, increased hospital stay and additional medical expenses. A unique relationship is assumed between the error category (level of damage, D_i) and the exogenous probability of detection, q_i, if choosing not to report, where $q_{AE} > q_{NM}$.[22] Errors with outcomes that inflict much discomfort for the patient are more difficult to hide from the regulator. For each error category two states are possible ([H]igh and [L]ow) each described by a certain liability probability; $r_{i,j}$ where $i = AE, NM$ and

[20] It follows from this specification that providers can be held liable for not reporting even if not held liable for an error. Even more flexible penalty regimes could be introduced e.g. by allowing penalties to depend on social costs.

[21] The noisy negligence rule implies that the occurrences of errors are accidental (fallible humans). An additional justification for such a specification is contractual (transaction) costs.

[22] The detection probability points to a market failure (imperfect monitoring). This probability is here exogenous and costless since a share of errors always becomes common knowledge through patient complaints and reports.

$j = H, L$.[23] Thus four error types may occur differing w.r.t the probability of being held liable.[24] Let β and $1-\beta$ be the share of adverse events and near misses, respectively, while v_{ij} is the share of errors of category *i* with liability probability *j,* where $\sum_{i,j} v_{ij} \leq 1$ and where q_i, β, $p(e)$, and v_{ij} are common knowledge.

It is assumed that both modes of ex-post behaviour (reporting or the failure to report) involve penalties beyond those following from formal penalties in terms of feelings of shame and guilt. Such penalties, in the following denoted as informal ones, are allowed to vary across error types. Given the decision to self-report, a cost b_{ij} (shame parameter) is introduced, which may reflect i) patient and patient family anger, ii) social condemnation and the feeling of being singled out, exposed and one's competence questioned, and iii) possible effects on future career and earning possibilities due to reputation losses.[25,26] For physicians who decide to keep silent about errors, a parameter a_{ij} is introduced (a guilt-parameter) to reflect the fear of being discovered as well as the moral costs that goes with the violation of the ethical responsibility to inform both patients and the regulator about error episodes. A high value of a_{ij} is likely in medical cultures with a strong professional ethics. Both parameters (b_{ij} and a_{ij}) may also include the physicians' concern for the patient (feelings of guilt and remorse) given the occurrence of an error.

The second period decision (ex-post) is first studied. At this stage of the game, they know whether an error has occurred, and if so, which particular type they are confronted with. The expected penalties, given the occurrence of an error of type *ij*, are;

$$SR_{ij} = b_{ij} + r_{ij}t_i + (1-r_{ij})0 = b_{ij} + r_{ij}t_i \qquad \text{where} \quad i = AE, NM \text{ and } j = H, L \qquad (1)$$

This probability may of course be increased by investing resources in medical reviews but this measure is not considered in this analysis.

[23] Liability probabilities are potential policy instruments, being influenced by the definition of due care (strictness of the negligence rule) and resources invested in review processes, but are here treated as exogenous variables.

[24] Errors can not always be attributed to negligence, carelessness or incompetence since being unpreventable (normal risks) or because of scientific, clinical or legal uncertainties.

[25] Leape and Berwick (2000) describes medical cultures as cultures of shame, where the mechanism of "shaming, naming and blaming" acts as a barrier to a free sharing of information. See also Rosenthal (1995).

$$NR_{ij} = a_{ij} + q_i[r_{ij}(t_i + s_i) + (1 - r_{ij})0] = a_{ij} + q_i(r_{ij}t_i + s_i) \text{ where } i = AE, NM \text{ and } j = H, L \quad (2)$$

where SR_{ij} denotes the expected penalty if an error of type ij is reported to the regulator, while NR_{ij} is the expected penalty if the physician fails to report the same incident. It is observed from (1) that the expected self-report penalty is the sum of the shame parameter and the expected accountability penalty (the product of the actual probability of being held liable, r_{ij}, and the accountability penalty itself, t_i). The expected non-report penalty (see 2) is the sum of three terms; the parameter reflecting guilt, the expected penalty associated with the act of non-reporting, and the expected penalty associated with being held liable for the occurrence of a medical error (negligent behaviour). Note that the self-report penalty, SR_{ij}, depends only on the accountability penalty, t_i, while NR_{ij} is a function of both formal penalties (t_i and s_i).

The condition that ensures that physicians self-report, given the occurrence of an error of type *ij*, is;

$$SR_{ij} \le NR_{ij} \Rightarrow b_{ij} + r_{ij}t_i \le a_{ij} + q_i(s_i + r_{ij}t_i) \Rightarrow b_{ij} - a_{ij} \le q_i s_i + r_{ij}t_i(q_i - 1) \quad (3)$$

It follows from (3) that the moral cost differential, $m_{ij} \equiv b_{ij} - a_{ij}$, defined as the "shame" associated with self-reporting subtracted the "guilt" that goes with lying low, has an important effect on reporting incentives. Given a shame-dominated culture, $m_{ij} > 0$, a high non-report penalty (s_i) and a low accountability penalty (t_i), are needed to induce health care workers to self-report.

The first-period decision (ex-ante), where physicians decide on preventable activities (precautionary care), and before knowing whether an error will occur, and if so what type, follows from;

$$\underset{e}{Min}\ C^p = e + p(e)R^a(t_{AE}, t_{NM}, s_{AE}, s_{NM}), \quad (4)$$

where $R^a(t_{AE}, t_{NM}, s_{AE}, s_{NM}) = \sum_{i,j} v_{ij} \min\left\{b_{i,j} + r_{i,j}t_i;\ a + [r_{i,j}t_i + s_i]q_i\right\}$

[26] Sexton, Thomas and Helmreich (2000) reports that more than half of the intensive care staff finds it difficult to discuss mistakes because of personal reputation and possible disciplinary actions.

Physicians are assumed to minimise the sum of preventive costs, e, and the product of the probability and the expected (ex-ante) penalty. The outcome, given the non-occurrence of an error, with probability $1-p(e)$ is zero.

In order to derive the first-best penalty scheme, the optimal solution needs to be defined. The optimal level of effort is determined by the following expression;[27]

$$e^* \equiv \arg\min_e \; C^r = e + p(e)\beta D_{AE} \tag{5}$$

It is now straightforward to show that optimal deterrence (optimal preventive effort), e^*, is the level that equates the marginal increase in effort costs with the marginal expected decline in social costs. Furthermore, the quality of error information is assumed the same for both error types. In addition, information quality is independent on the way errors become common knowledge – whether self-reported or detected. In both cases the quality of information is here normalised to *1*, which implies that the expected quality of information is *1* and q_i, for self-reported and non-reported errors, respectively.[28] Since the regulator is indifferent to the information source, she is always better off in expectancy terms, given self-reporting behaviour.[29] The above discussion makes evident why the first–best solution is one for which all physicians self-report and where each of them invest e^* into preventive effort.

Optimal deterrence is now achieved by inducing the decision-maker to internalize all societal costs. This is done by imposing the following condition; [30]

$$\beta D_{AE} = R^a_{SR}(t_{AE}, t_{NM}, s^*_{AE}, s^*_{NM}) = \sum_{i,j} v_{ij}[b_{i,j} + r_{i,j}t_i] \tag{6}$$

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[27] A possible extension would be to count moral costs (b_{ij} and a_{ij}) as social ones. However, it is not obvious that e.g. the fear of being detected and discomfort associated with non-compliance to law, should be included.

[28] In this paper, it is not focused at how to analyse and use information in order to translate negative results into useful information. A rather simple approach is chosen where the number of collected reports linearly increases the quantity and value of information, hence reducing the future problem medical errors.

[29] The benefits associated with error information (e.g. in terms of a lower future frequency of errors) are not explicitly integrated into (7) for ethical reasons. The possibility for an optimal policy to allow for a lenient deterrence level (a high probability for errors) in order to gain additional error information is ruled out (lexicographic preferences).

[30] In the following it is assumed that $\sum_{i,j} v_{ij} = 1$.

where $R^a_{SR}(t_{AE}, t_{NM}, s^*_{AE}, s^*_{NM})$ is the expected (ex-ante) penalty given the existence of non-reporting penalties that ensure self-reporting for all error types. Rearranging (6) yields;

$$t^*_{AE} = \frac{\beta D_{AE} - \eta t^*_{NM} - \bar{b}}{\sigma}, \tag{7}$$

where $\eta = \sum_j v_{NM,j} r_{NM,j}$, $\delta = \sum_j v_{AE,j} r_{AE,j}$ and $\bar{b} = \sum_{i,j} v_{ij} b_{ij}$.

η and δ are the expected probabilities of being held liable for a near miss and an adverse event, respectively while $\bar{b}$ is expected moral costs (shame) being associated with self-reporting behaviour. All combinations of t_{AE} and t_{NM} that simultaneously fulfil (7) represent a menu of optimal penalty levels. It is observed that a higher value of t_{NM} yields a lower value of t_{AE} and that each penalty can be set equal to zero without abstaining from the possibility to induce first-best effort. Consider now the case for $t_{NM} = 0$ and expected social error costs, βD_{AE}, exceeding expected "shame", $\bar{b}$, which yields an optimal value of t_{AE} being positive. If, on the other hand, $\beta D_{AE} < \bar{b}$, defensive medicine (over-deterrence) is experienced, and t_{AE} must now be negative to get the incentives right. It also follows that t_{AE} decreases with the expected liability probability for adverse events (δ). Note that detection probabilities have no effect on the optimal penalty levels, since the risk of being detected matters for those who fail to report, only. A complete or partly inclusion of physician moral costs (b_{ij} and a_{ij}) as social ones would change (7). The optimal penalty levels would now be higher for the same parameter values, since the expected social costs associated with errors are higher given such an assumption.

The next step is to determine the optimal levels of the non-report penalties so that self-reporting behaviour is induced irrespective of error type. To solve this problem we first define the level of s_{ij} that makes the optimal self-report rule (see 3) binding for each error type. This procedure provides us with the following four critical levels;

$$\bar{s}_{ij} = \frac{m_{ij} + r_{ij} t^*_i (1 - q_i)}{q_i} \tag{8}$$

where $\overline{s}_{ij}$ is the lowest possible value s can attain, for error type ij, and still be able to induce self-reporting behaviour. The first-best non-report penalties become;

$$\begin{aligned} s^*_{AE} &\geq \max\left\{\overline{s}_{AE,j}\right\} \\ s^*_{NM} &\geq \max\left\{\overline{s}_{NM,j}\right\} \end{aligned} \tag{9}$$

The expressions in (9) say that the optimal non-report penalty for each error category (AE and NM) is to be higher (or equal to) than the highest critical level for s_{ij} defined by (8) for each error category.

In order to undertake a complete ranking of the critical levels defined in (8) we impose the following assumptions;

$$m_{i,H} = b_{i,H} - a_{i,H} \geq b_{i,L} - a_{i,L} = m_{i,L} \tag{10}$$

By using (10) and $r_{AE,H} > r_{AE,L}$ and $r_{NM,H} > r_{NM,L}$, the following ranking matters;

$$\overline{s}_{i,H} > \overline{s}_{i,L} \tag{11}$$

Consequently, the first-best non-report penalties are now identified and become;

$$s^*_{AE} \geq \overline{s}_{AE,H} = \frac{m_{AE,H} + r_{AE,H} t^*_{AE}(1 - q_{AE})}{q_{AE}} \tag{12}$$

$$s^*_{NM} \geq \overline{s}_{NM,H} = \frac{m_{NM,H} + r_{NM,H} t^*_{NM}(1 - q_{NM})}{q_{NM}} \tag{13}$$

The optimal level in (12) ensures that adverse events with a high liability probability are self-reported, while (13) yields the same outcome for near misses. The same two penalty levels also induce self-reporting for errors with a low liability probability, since for any level of t and s, self-reporting incentives are most significant for such errors. If the conditions in (12) and (13) are binding and both accountability penalties described in (7) are positive, it follows that s^*_i is strictly increasing with the liability probability (r_{ij}) and the importance of shame relative to guilt (m), while s^*_i is strictly decreasing with the detection probability (q_i).

The penalty scheme described by (7), (12), and (13) is the optimal one. Now both ex-ante and ex-post incentives are socially correct. The same three equations make evident the interdependency

that exists between accountability and non-report penalties. A higher accountability penalty for any error category makes it necessary to adjust upwards the non-report penalty for the same error category.

2. The IOM policy proposal.

The IOM policy proposal will now be evaluated. This proposal suggests mandatory reporting for adverse medical events (punitive environment) and voluntary reporting (non-punitive) for near misses. Unfortunately, it is not perfectly clear from the report what is actually meant by mandatory reporting systems. In particular, whether mandatory reporting includes the possibility of penalising individuals for not reporting errors, hence two possibilities are discussed below.[31]

Case I) t_{AE} and s_{AE}

Case II) t_{AE}

It follows that penalties targeted at near misses are unavailable in both cases since voluntary reporting implies the non-existence of any formal penalties.[32] The two cases differ, however, for adverse events. In Case II, mandatory reporting includes the possibility of imposing an accountability penalty, while in Case I mandatory reporting is interpreted as a regime that may impose non-report penalties for adverse events as well.[33]

First case I is considered. By imposing the above conditions onto the optimal penalty scheme in section 2 [see (7), (12) and (13)], we arrive at the following expressions;

$$t_{AE} = \frac{\beta D_{AE} - \bar{b}}{\sigma} \tag{14}$$

$$s_{AE} \geq \frac{m_{AE,H} + r_{AE,H} t^*_{AE}(1-q_{AE})}{q_{AE}} = \frac{m_{AE,H} + r_{AE,H}\left[\dfrac{\beta D_{AE} - \bar{b}}{\delta}\right](1-q_{AE})}{q_{AE}} \tag{15}$$

$$t_{NM} = s_{NM} = 0 \tag{16}$$

[31] See chapter 5 and 6 in IOM (2000) and Barach and Small (2000).
[32] This interpretation seems to be in accordance with the description given by IOM (see section 1).
[33] We do not consider various costs being associated with operating error reporting systems. Such costs may be considerable and will most probably differ across reporting systems.

The penalty level in (14) yields optimal deterrence when all errors are self-reported, hence ex-ante incentives can be socially correct even when t_{NM} is unavailable. The optimal non-report penalty in (15) ensures that all adverse events are self-reported. However, as concerns near misses there is no available instrument to influence self-reporting incentives hence the reporting decision will depend on model parameters. The optimal self-report rule for near misses (see 3) in Case I becomes;

$$b_{NM,j} \le a_{NM,j} \Rightarrow m_{NM,j} \le 0, \tag{17}$$

hence near misses will be self-reported in medical cultures with a strong professional ethics (guilt-dominated cultures), consequently first-best is unattainable in shame-dominated cultures ($m_{NM,j} > 0$).

Now, case II is considered. By imposing the relevant conditions for this case onto (7), (12) and (13), (14) remains unchanged while (15) now is equal to zero. As before, (14) defines optimal deterrence, when all errors are self-reported. The conclusions arrived at in Case I still prevail for Case II as concerns reporting incentives for near misses. However, the absence of s_{AE} makes it necessary to investigate self-reporting incentives for adverse events. The optimal self-report rule for adverse events, for case II, is;

$$b_{AE,j} + r_{AE,j} t^*_{AE} < a_{AE,j} + q_{AE} r_{AE,j} t^*_{AE} \tag{18}$$

Now, by using (14) and rearranging (18), we arrive at the following condition;

$$m_{AE,j} \le t^*_{AE} r_{AE,j} (q_{AE} - 1) = \frac{\left[\beta D_{AE} - \bar{b}\right] r_{AE,j} (q_{AE} - 1)}{\delta} \tag{19}$$

Given a positive value of the accountability penalty, $\beta D_{AE} - \bar{b} > 0$, it is observed from (19) that strong professional ethics (a guilt-dominated culture; $m_{NM,j} \le 0$) is not sufficient to ensure self-reporting of adverse events. This conclusion follows because of $r_{AE,j}(q_{AE} - 1) < 0$ which measures the difference in the expected penalty across the two modes of behaviour (non-reporting and reporting). In order to induce self-reporting of adverse events, the moral costs differential ($m_{AE,j}$) must now be negative. Hence, a guilt-dominated culture is not sufficient to ensure self-reporting of all adverse events. It is also observed that a low detection probability for adverse events, a high liability probability, and a high accountability penalty, make self-reporting less likely.

In case I it is shown that the presence of a non-report for adverse events ensures that such errors become self-reported while near misses become self-reported only if medical cultures have a strong professional ethics (guilt-dominated culture). The presence of the same culture, however, is not sufficient to induce the first-best when both non-report penalties are unavailable as regulatory instruments (Case II). This result follows from the relationship between the optimal accountability penalty and the optimal non-report penalty (see 3). An adverse event accountability penalty that induces optimal deterrence, acts on the same time as a disincentive for self-reporting adverse events. Consequently, the ability to reach the first-best in Case II is reduced with the size of the accountability penalty (degree of deterrence). This property is absent for medical near misses, both in Case I and II, since a near miss accountability penalty is not present. A final observation is that the presence of one accountability penalty, only, is sufficient to create the socially correct ex-ante incentives (deterrence). However, an accountability penalty for each error category (adverse events and near misses) introduces additional flexibility, since the regulator now can choose from a menu of penalty levels that all induce the first-best effort level.

3. Conclusion

The economic literature on error prevention is primarily concerned with malpractice systems (see e.g. Simon, 1982 and Danzon, 2000) with a focus on optimal insurance, precautionary care (deterrence) and patient compensation. The medical literature, on the other hand, is increasingly concerned with reporting incentives and the learning potential from knowing about errors (adverse events as well as near misses). The analytical model presented here represents a structured way of thinking about error prevention and reporting incentives and can be used to pre-evaluate the effectiveness of various proposed incentive systems. It is shown that penalty regimes that held decision-makers liable for the occurrences of negligent adverse events (precautionary care) and the non-reporting of both error categories can induce the first-best solution.

A contingent error reporting system, as suggested by the Institute of Medicine (IOM), that held medical decision-makers responsible for adverse events only, is not an optimal one. This scheme is able to address ex-ante incentives (optimal deterrence), but will not ensure that all errors, if they

occur, become common knowledge (self-reported). Near misses become self-reported only if the feeling of shame that goes with self-reporting is less than the guilt associated with keeping near misses a secret (guilt-dominated culture). However, the same culture is not able to ensure the self-reporting of adverse events. Evidence on medical errors confirms that errors are significantly underreported, which suggests "shame-dominated" cultures in health care. Consequently, non-report penalties seem crucial for being able to learn from error incidents in order to reduce the future adverse event frequencies.

A problem with the IOM report is that the proposal is not discussed in relation to current institutions e.g. it remains unclear whether the proposed reform is to replace or be integrated into malpractice systems. Anyway, this analysis shed light on the efficiency properties of malpractice systems for which near misses liability and reporting incentives are ignored but where decision-makers are only partly held liable for adverse events since being shielded from financial risks due to liability insurances. Hence, the adverse event accountability penalty is Case II can be interpreted as the provider liability risk (co-insurance rates, time costs and possible reputation effects). The above discussion shows that absent near miss liability does not represent a social problem as concerns deterrence incentives since they can be addressed by adverse event liability. However, the liability risk in malpractice systems is not generally controlled by the regulator, and interventions in liability insurance markets are mainly done to control premiums and such reforms are not expected to change deterrence incentives since experience-rated contracts are rare in malpractice systems (Sloan, 1990). Several studies confirm the practicing of defensive medicine (over-deterrence) as well as underreporting of adverse events. This analysis points to significant informal costs (blame and guilt), high liability probabilities, and the absence of non-reporting penalties as possible explanations.

References

Barach, P. and Small, S.D., (2000), Reporting and preventing medical mishaps: lessons from non-medical near miss reporting systems, British Medical Journal 320: 759-763.

Bovbjerg, R.R., Miller R.H., and Shapiro, D.W., (2001), Paths to reducing medical injury. Professional liability and discipline vs. patient safety – and the need for a third way, Journal of Law and Medical Ethics 29: 369-380.

Brennan, T.A., Sox, C.M., and Burstin, H.R., (1996), Relation between negligent adverse events and the outcomes of medical-malpractice litigation, New England Journal of Medicine 335: 1963-1967.

Brennan, T.A., (2000), The Institute of Medicine Report on medical errors – could it do harm?, The New England Journal of Medicine 342: 1123-1145.

Cohen, M. R., (2000), Why error reporting systems should be voluntary, British Medical Journal 320: 728-9.

Cullen, D.J., Bates, D.W., Small S.D., Cooper, J.B., Nemeskal, A.T. and Leape L.L., (1995), The incident reporting system does not detect adverse drug events. A problem for quality improvement, Jt Comm J Qual Improv 21: 541-8.

Danzon, P.M., (2000), Liability for medical malpractice. In: Culyer A.J. and Newhouse, J.P. (eds.,); Handbook of Health Economics 1, Elsevier science.

DH (Department of Health), (2000), An organisation with a memory. Report of an expert group on learning from adverse events in the NHS chaired by the Chief Medical Officer. London: Stationery Office.

ISMP (The Institute of Safe Medical Practices), (1999), Voluntary error reporting is best public policy, ISMP Medication Safety Alert 4, 1.

IOM (The Institute of Medicine), (2000), To err is human: building a safer health system, (eds.,) Kohn, L.T., Corrigan, J.M., and Donaldson M.S., National Academy of Science, Washington D.C.: National Academy Press.

Kaplow, L. and Shavell, S., (1994), Optimal law enforcement with self-reporting behaviour, Journal of Political Economy 102: 583-606.

Leape, L.L and Berwick D.M., (2000), Safe health care: are we up to it? British Medical Journal 320: 715-6.

QuIC, (2000), Doing what counts for patient safety: federal actions to reduce medical errors and their impact, Report of the Quality Interagency Coordination Task Force to the President, February.

Reason, J., (2000), Human error: models and management, British Medical Journal 320: 768-770.

Reinertsen, J. L., (2000), Let's talk about error, British Medical Journal 320: 750 –753.

Rosenthal, M.M., (1995), The incompetent doctor. Behind closed doors, Buckingham: Open University Press.

Runciman, W.B. and Moller, J., (2001), Iatrogenic injury in Australia. A report by the Australian Patient Safety Foundation.

Sage, W.M., (2003), Medical liability and patient safety, Heath Affairs 22: 26-36.

Sexton, B.J., Thomas, E.J., and Helmreich, R.L., (2000), Error, stress, and teamwork in medicine and aviation: cross sectional surveys, British Medical Journal 320: 745 – 749.

Simon, M.J., (1982), Diagnoses and medical malpractice: a comparison of negligence and strict liability systems, Bell Journal of Economics 13: 170-180.

Sloan, F.A., (1990), Experience rating: does it make sense for medical malpractice insurance, American Economic Review, Papers and Proceedings 80: 128-133.

Studdert, D.M. and Brennan, T.A., (2001), No-fault compensation for medical injuries: the prospect for error prevention, Journal of the American Medical Association 286: 217-223.

Studdert, D.M. et al., (2004), Medical malpractice, The New England Journal of Medicine 350: 283-292.