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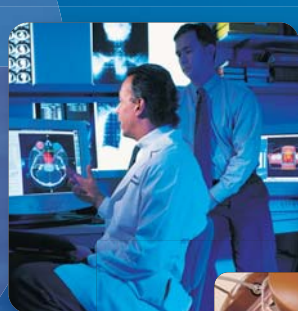
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## D I S C U S S I O N   P A P E R



### Reassessment of Health Technologies: Obsolescence and Waste



*Supporting Informed Decisions*

Until April 2006, the Canadian Agency for Drugs and Technologies in Health (CADTH) was known as the Canadian Coordinating Office for Health Technology Assessment (CCOHTA).

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**Canadian Agency for Drugs and Technologies in Health**

**Reassessment of Health Technologies:  
Obsolescence and Waste**

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Tom Noseworthy was the lead researcher and principal investigator.

All authors approved the final draft.

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Authors declared no conflicts of interest.



# EXECUTIVE SUMMARY

This report promotes discussion about health technology obsolescence, considers related practical and policy issues, and proposes a framework for advancing the reassessment and decommissioning of health technologies in Canada.

Methodologically sound assessments of health technologies have produced gains for stakeholders in safety, efficacy, and cost-effectiveness. Although the assessment field is growing, the reassessment and decommissioning of health technologies have not yet become a focus. Decommissioning and disinvestment in obsolescent technology may be a means of reducing the rise in health care costs and of improving safety and effectiveness.

Obsolescence is an end-point of all technology, which can progress through a life cycle that encompasses ideas, innovation, invention, investigation, adoption, acceptance, reduced use, and obsolescence. These stages may be difficult to differentiate because of the multi-faceted nature of health care technologies, but it can be assumed that a health technology is at one or more stages of this continuum.

Because current health technology assessments (HTAs) conform to standard methods and metrics and because there is an international community focusing on this area, we can assume that the capacity can be expanded to undertake reliable reassessments. A systematic approach that can be used to prioritize reassessments of health care technologies offers promise in the decommissioning of obsolete technologies.

Obsolescence may occur when newer products or technologies supersede the old, leading to decommissioning and delisting. Such cases occur when the costs of maintenance or repair outpace the benefits of replacement technology. Most obsolescence occurs when a newer technology is more user-friendly, safer, more efficient, more effective, or more cost-effective, thus leading to substitution for the previous technology. Technological innovation and improvements do not occur linearly over time. As a result, a systematic and integrated approach to assessments and reassessments is needed to deal with technological obsolescence.

Because HTAs have been focused on new technologies, a shift is needed to focus on the product life cycle, which spans historical development, future applications, and decommissioning. By elucidating obsolescent technologies, this shift in focus offers an opportunity to provide safer, more effective, or more cost-effective substitutes. As a result, patients receive safer and more effective treatment. Because the amount of unnecessary medical care is reduced, the risks of associated complications are reduced. Health care professionals have more capacity to offer safer or more effective treatments while being less burdened by technological limitations and complications. Moreover, payers and decision-makers can focus on the decommissioning of obsolescent technologies. Through disinvestment, they reduce costs and identify possible avenues for reinvestment.

To proceed with the development of a policy framework for health technology obsolescence, it is necessary to consider the life cycle of health technologies and to focus on where reassessment is best positioned. Health technologies go through the often overlapping stages of experiment,

introduction, and adoption. It is challenging to create a model in which a less effective health technology in stable use could be decommissioned. Comparable cases from industry and other countries can be used to inform the model. For instance, time is an insufficient mechanism for the transition of a less effective health technology from stable to reduced use and decommissioning. Processes must occur in the early and later stages of the life cycle to enable the gathering of information on safety, efficacy, cost-effectiveness, and stakeholders' perspectives.

An oversight body with the required skills, expertise, and resources could handle the triggers that occur along the life cycle. Provincial oversight bodies are needed, although a multi-provincial or pan-Canadian approach offers the potential of greater value. The triggers, which act as prompts to inform the oversight body, could be proactive, such as obsolescence forecasting, or reactive, such as provincial and regional experience or events. These triggers contain information that should be considered by the oversight body, which would use it to make informed decisions about reassessment, reduced use, disinvestment, and decommissioning.

There is an association between obsolescence and the overuse, underuse, and misuse of health technologies, practices, and procedures. Canada and the provinces and territories need to engage in a systematic process to reassess health technologies for reduced use or decommissioning. We suggest a model of reassessment and offer an approach to improving effectiveness without distinguishing between obsolescence and waste.

# GLOSSARY

**Adverse event:** A negative outcome that occurs during or after the use of a drug or other intervention but is not necessarily caused by that intervention.<sup>1</sup>

**Clinical effectiveness:** The extent to which an intervention does what it is intended to do when it is used in ordinary circumstances.<sup>1</sup>

**Cost-effectiveness:** The value for money; for example, a treatment is cost-effective if it provides a greater health gain than could be achieved by using the resources in other ways.<sup>2</sup>

**Decommission:** To remove (a ship or nuclear power plant, for example) from service.<sup>3</sup>

**Delisting:** The discontinuation of public insurance for a health service.

**Design refresh:** The changes made to a technology at one or more points in its life cycle to update functionality and manage obsolescence.<sup>4</sup>

**Disinvestment:** The displacement of non-cost-effective technologies for resource reinvestment or reallocation.<sup>5</sup>

**Focused use:** The use of a device that is limited to those indications for which there is sufficient evidence of clinical effectiveness and cost-effectiveness.

**Health technology:** A drug, device, medical procedure, or surgical procedure and the administrative and supportive system in which health care is delivered.

**Health technology assessment:** The systematic evaluation of properties, effects, or other impacts of health technology (the purpose of health technology assessment is to inform policy-making for technology in health care).<sup>6</sup>

**Indication:** A symptom or circumstance that points to the advisability or necessity of a medical treatment or procedure.<sup>7</sup>

**Misuse:** The use of a technology for purposes other than those for which it was originally intended in the absence of evidence that doing so is clinically effective and cost-effective (for example, scope creep).

**Obsolescence:** The end point in the life cycle of a health technology (occurs when a new technology supersedes the old).

**Overuse:** The use of technology more often than is indicated.

**Reassessment:** A systematic review of a health technology, occurring after an initial assessment, to determine whether it is safe, clinically effective, and cost-effective.

**Systematic review:** A review that looks at a clearly formulated question and that uses systematic and explicit methods to identify, select, and critically appraise relevant research and to collect

and analyze data from the studies that are included in the review. Statistical methods (meta-analysis) may be used to analyze and summarize the results of the included studies.<sup>1</sup>

***Teratogenic:*** Of, relating to, or causing developmental malformations.<sup>7</sup>

***Trigger:*** A prompt, event, or evidence that leads to re-evaluation of the clinical effectiveness of a health technology. These may be forecast, activated, or timed.

***Underuse:*** The use of a technology less often than is indicated.

***Waste:*** The misuse or overuse of a health technology.

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# 1 CONTEXT

This report promotes discussion on practical and policy issues about health technology obsolescence and offers a framework for advancing the reassessment and decommissioning of health technologies in Canada.

This work is based on a focused literature review and input from experts. It is a narrative review that proposes a model for policy and action. It is not a synthesis of all available evidence that has been analyzed systematically.

Systematic health technology reassessments are as important as initial health technology assessments. Reassessments can be used to determine if technologies are safe, efficacious, and cost-effective compared with an alternative. Given the fact that many technologies have not been subject to initial rigorous HTA to define appropriate use, misuse, overuse, and obsolescence must be considered in reassessments. Waste (the misuse or overuse of a health technology) creates many of the same issues that are created by obsolete technology, resulting in less safe, less effective, and less cost-effective health care. When a health technology is overused, it is being used more than is considered to be appropriate. Underuse is the opposite. When a technology is misused, it is being used to fulfill additional purposes beyond the original indications (scope creep). For example, electroencephalography (EEG) is used in the diagnosis of neurologic disorders, such as epilepsy. Contrary to the indications that are listed in clinical guidelines and despite the lack of supportive evidence, EEGs often are ordered when there is a low clinical suspicion of epilepsy or in cases of confirmed epilepsy to monitor drug withdrawal or investigate a clinical change in seizures.<sup>8</sup> There have been many examples of obsolete and wasteful health care technologies that have been eventually retired. Many other outdated and ineffective health technologies remain in use.

Provinces and regions regularly evaluate whether new technologies are cost-effective and whether to pay for them in the publicly funded health care system. Yet new technologies and techniques are being insured with varying degrees of prior evaluation. If health care resources are finite, how can we continue to insure technologies and services without delisting something?

By 1990, it was estimated that the use of new technology and the overuse of existing technology accounted for up to 50% of the rise in health care costs.<sup>9</sup> Reassessment, which is part of the solution, is a process that yields information on the effectiveness of a technology and how it is to be used. Such determinations are integral to quality improvement and optimization of care. We propose that, in Canada, there should be systematic processes and regular reviews to reassess practices, drugs, and devices.

Obsolescence occurs during the life cycles of all technology. In this report, we review obsolescence, examine best practices from other fields, discuss practical and policy considerations that are relevant to health technology reassessment in Canada, and offer a proposed framework for action.

## 2 WHAT IS OBSOLESCENCE?

As time passes, everything ages. Technical or functional definitions of obsolescence involve situations such as those that arise when “a new, more functional product or technology supersedes the old” or when the cost of maintenance or repair of old technology outpaces the benefits of a new piece of technology.<sup>3</sup>

Banta and Thacker discuss obsolescence:

The replacement of productive equipment ranks among the most important strategic decisions faced by both manufacturing and service firms. This is because purchase of a new piece of equipment often involves a significant cost and can affect the productivity and competitiveness of the firm, such as a hospital, for several years into the future. In recent years, the difficulty of this problem has been compounded by the fact that the technologies area is rapidly changing and what may appear to be a good equipment purchase can soon become obsolete. Under these circumstances, the driving motivation behind replacement decisions is likely to be technological obsolescence, rather than physical deterioration, of the existing equipment. This situation is typical of microcomputers, computerized numerically controlled machines and other electronics technologies.<sup>9</sup>

In traditional thinking about obsolescence, it is assumed that technological advances happen linearly over time. Many authors, however, have shown that there is little or no predictive capacity for future developments.<sup>10</sup> Moreover, obsolescence in technology usually does not occur through physical deterioration and occurs only when the cost of maintaining the old technology outweighs the total cost of buying a new version.<sup>10-12</sup> In most cases, machines rarely wear out and break down. Usually, a newer technology is more user-friendly, safer, more efficient, more efficacious, more effective, or more cost-effective, thus leading to the obsolescence of the previous technology.<sup>10,11</sup> This scenario is complicated by other factors, such as investment in training, the competence of technicians, or the impact of those who may have a vested interest in maintaining the status quo.<sup>13</sup>

During technological innovation, some decision-makers may choose to keep a technology for years before replacing it. They may believe that there will be a better version of the new technology.<sup>11</sup> For example, laser eye surgery for refractive disorders has been available for more than a decade, yet many consumers waited for the technology to improve before undergoing the procedure. This supports the assumption that although technological innovation occurs cyclically or in bursts, the quality improvement of technology occurs more linearly over time.

## 3 OBSOLESCENCE OF TECHNOLOGY

Technology can have a life cycle that is comparable to that of organisms.<sup>10,11,14</sup> There are stages when the technology exists as a concept, other times when it is established, and eventually it is an afterthought. The National Institutes of Health characterizes health care technologies by stages (Table 1).<sup>12</sup>

| <b>Table 1: Stages of Technological Life Cycle</b> |  |
|--|--|
| <b>Future</b>                                      | In conceptual stage, anticipated, or in earliest stages of development                                     |
| <b>Experimental</b>                                | Undergoing bench or laboratory testing using animals or other models                                       |
| <b>Investigational</b>                             | Undergoing initial clinical (in humans) evaluation for a condition or indication                           |
| <b>Established</b>                                 | Considered by providers to be standard approach to a condition or indication and diffused into general use |
| <b>Obsolete, outmoded, abandoned</b>               | Superseded by other technologies or demonstrated to be ineffective or harmful                              |

Source: Goodman.<sup>12</sup>

These stages are not mutually exclusive and can apply to technology in different settings.<sup>12,14,15</sup> For example, thalidomide, which was a drug that was marketed for sedation in pregnant women, was found to be teratogenic.<sup>9,12,16</sup> The ensuing lawsuits and the implications were responsible worldwide for the tightening of laws and processes on the adoption of drugs. Although thalidomide remains obsolete in certain situations and has been abandoned for treating pregnant women, its use in cases of leprosy was never stopped. In addition, there are new uses, such as the treatment of symptoms in patients with HIV.<sup>9,12,16</sup> The life cycle of a technology is multi-faceted and multi-dimensional, depending on the nature and number of uses.<sup>11,15</sup>

## 4 HEALTH TECHNOLOGY ASSESSMENTS

HTAs provide clinical and economic evaluations of new technologies and are used by decision-makers when considering the purchase of drugs or medical devices.<sup>10-13,15,17</sup> The focus of most assessments is on newer rather than older technologies.<sup>3,9-11,15,17</sup> This seems to make sense. Why reassess old technologies if they have been found to be clinically effective and cost-effective? The answer lies in the improved assessments being done today compared with those that were done 30 years ago. Technology assessments, including HTAs, began in the 1970s in the United States. They were used to investigate the safety and effectiveness of technologies and were the product of social and ecological concerns.<sup>12,15,17,18</sup> In addition, the waiting times between positive assessments and the incorporation of technology into practice could be a decade or more (consider, for example, the lag time in the introduction of the use of aspirin after myocardial infarction).<sup>18</sup> Moreover, new technologies were being adopted in place of existing technologies, even if the newer technologies were not equal or better choices.<sup>17,18</sup> The report found that some procedures, such as caesarean section, were occurring more often than was medically necessary.<sup>18</sup> These examples are not illustrative of technological obsolescence in the use of devices. From the perspective of practice and mindset, however, these examples are illustrative of technological obsolescence. Because many procedures and models of care have become standard practice without prior assessment and then reassessment, the distinction between obsolete and wasteful practices is blurred. Moreover, a technology may not be obsolete, but some of its indications might be.

As evidence-based medicine has gained momentum, HTAs have been improved by the use of “high-quality scientific evidence and meta-evidence in the form of systematic reviews.”<sup>17</sup> This emphasis incorporates the contextual situation of a technology and increases the capacity to

evaluate comparative effectiveness, cost-effectiveness, and overall value with a consideration of ethical, legal, and social issues.<sup>12,18</sup> Many stakeholders have become interested in HTAs and information management. This has increased the potential of organizations to perform HTAs and to supply evidence to groups who are interested in the results of these assessments.<sup>12,17,18</sup>

As HTA emerged, standard methods, metrics, reviews, and peer-reviewed publications were created. The assessments that were conducted were generally of a higher quality when they were compared with previous assessments.<sup>15,19</sup> The level of international collaboration has grown among groups such as Health Technology Assessment International (HTAi), and EuroScan, for example.<sup>17</sup> As a result, HTAs rarely occur in isolation and are more reliable and more extensive than in the past.

In Canada, there are mechanisms by which health technologies enter the system, but there are no similar mechanisms for reassessment and decommissioning. This can be rectified because HTA organizations specialize in quality improvement and assessment.<sup>12</sup> With broader attention to obsolescence, the mandate of these organizations can be expanded to include reassessment and the development of better mechanisms for managing contextual factors. The delisting of obsolete technologies increases the quality of available care. If reallocation of funding (disinvestment) is possible, then costs can be contained.<sup>15,19,20</sup> Changing the focus from the adoption of technologies to product life cycle assessments and reassessments rebalances the flow of technologies into and out of the health care system.

A new approach on the part of the Canadian health care system is needed to address the fact that newer health technologies continue to be insured without corresponding delisting of older technologies. This approach would provide guidelines and mechanisms for establishing accepted health technologies, the contexts in which they are best used, and the times when they are reassessed.

Given the potential value to the health care system of disinvestment, a publicly funded approach to reassessments and decommissioning is realistic in Canada. This will also broaden the scope of organizations that seek to evaluate these technologies.

## **5 WHY IS OBSOLESCENCE OF HEALTH TECHNOLOGIES IMPORTANT?**

Because many current health care technologies were diffused before contextual analysis and cost-effectiveness became criteria for evaluation, many health services of limited effectiveness may be used in practice.<sup>19</sup> This is waste, not obsolescence. The National Library of Medicine lists examples of health care technologies that were found “to be ineffective or harmful after being widely diffused”<sup>12</sup> (Table 2).

**Table 2: Examples of Health Care Technologies Found to Be Ineffective or Harmful After Being Widely Diffused**

|  |
|--|
| Autologous bone marrow transplant with high-dose chemotherapy for advanced breast cancer |
| Colectomy to treat epilepsy  |
| Diethylstilbestrol (DES) to improve pregnancy outcomes                                   |
| Electronic fetal monitoring during labour without access to fetal scalp sampling         |
| Episiotomy (routine or liberal) for birth  |
| Extracranial/intracranial bypass to reduce risk of ischemic stroke                       |
| Gastric bubble for morbid obesity  |
| Gastric freezing for peptic ulcer disease  |
| Hormone replacement therapy for healthy menopausal women                                 |
| Hydralazine for chronic heart failure  |
| Intermittent positive pressure breathing   |
| Mammary artery ligation for coronary artery disease                                      |
| Optic nerve decompression surgery for nonarteritic anterior ischemic optic neuropathy    |
| Quinidine for suppressing recurrences of atrial fibrillation                             |
| Radiation therapy for acne   |
| Sleeping face down for healthy babies  |
| Supplemental oxygen for healthy premature babies   |
| Thalidomide for sedation in pregnant women   |
| Thymic irradiation in healthy children   |
| Triparanol (MER-29) for cholesterol reduction  |

Reproduced with permission from Goodman.<sup>12</sup>

Although most of these technologies are not used in current practice, their trajectories to reduced use or cessation have varied. Obsolescence, obsolete indications, and waste lead to ineffective or harmful therapy. In many cases, the use of technologies has been protracted beyond the availability of evidence suggesting obsolescence or waste.

The creation of best practice protocols that delineate focused indications and appropriate circumstances for procedures or tests can reduce costs. For example, EEG is a test that has been widely used to detect brain diseases. Although it is necessary in some situations, EEGs have been too widely used in general.<sup>8</sup> The number of tests that are done could be safely reduced if evidence-based protocols were followed. Waste, through the overuse or misuse of EEGs, does not make the technology obsolete. Such waste, however, leads to the delivery of less effective health care. This supports the argument for reassessment.

## 5.1 Patients

The decommissioning of health care technology serves the best interests of patients, health care providers, and the public. Due to increased safety and the comparative effectiveness of diagnosis and treatment, it is logical to assume that the benefit to patients will increase.<sup>12,17,21-24</sup> Patients benefit from the delisting of obsolete health technology when safer, more effective alternatives

become available. The delisting of obsolete technologies speeds the diffusion of more effective technologies.<sup>9,10,14</sup>

Focusing the use of a technology helps patients avoid the complications that can arise during or after a medical procedure.<sup>9,21</sup> For instance, an estimated 20% of women who have had a hysterectomy have no substantial abnormality on post-operative pathologic examination.<sup>9,21</sup> Although hysterectomies are the second most common surgical procedure in the United States, many unnecessary or inappropriate procedures represent examples of overuse or misuse. Moreover, an elective hysterectomy, as opposed to a clinically necessary one, leads to a reduced life expectancy or reduced quality of life.<sup>21</sup> It is unknown how many other procedures are routinely conducted based on insufficient evidence of appropriateness or need.

There have been concerns about the safety, appropriateness, and cost-effectiveness of health technologies. Blue Cross and Blue Shield's Medical Necessity Project, which began in 1976, was composed of medical societies such as the American College of Surgeons and the American College of Radiology. The project had a mandate to examine cost-ineffective and unsafe health technologies that could be subjected to reduced or focused use or decommissioning. It found that more than 76 technologies and techniques were obsolete and could be dropped from insured practice; for example, routine allergy testing or hyperbaric oxygen treatment of arthritis.<sup>9,12</sup> These technologies and techniques come with a capital expenditure and operating expenditures that are used to pay for the treatment of patients' morbidity and the consequences of patients' mortality.

## **5.2 Industry and Payers**

There are tangible benefits for industry and payers with the reassessment and decommissioning of obsolete health care technologies.<sup>14,20</sup> For industry, the delisting of old technologies allows reinvestment and the creation of newer technologies, perhaps opening broader approaches to complex chronic disease management. For payers and decision-makers, cost-reduction and an increased cost-effectiveness of interventions remain desirable. Internationally, the disinvestment of ineffective health technologies has become increasingly important, and cost reductions are anticipated.<sup>23-27</sup>

The creation of mechanisms for reassessment, reduced use, disinvestment, and decommissioning of obsolete and wasteful technology is in the best interest of all stakeholders.

## **5.3 Physicians and Health Care Providers**

For physicians and other health care providers, the benefits of reassessment and the decommissioning of technologies exist in parallel to those for patients.<sup>13,19</sup> Increased patient safety is a tenet of medical practice, and the increased effectiveness of interventions is a permanent goal. The use of more efficient or user-friendly devices can lessen the workload of health care providers. The Canadian Task Force on the Periodic Health Examination found that several tests and screening procedures were unnecessary; for example, routine screening for pancreatic and oral cancers, and routine electronic fetal monitoring.<sup>9,19</sup> Safer practices could reduce unnecessary morbidity and mortality, and litigation.

There are situations where the delisting of obsolete technologies and techniques, or restricting their use, can be seen as threatening to the practice, authority, or autonomy of physicians, health care professionals, and technicians. The case of intermittent positive pressure breathing (IPPB), which is described in this report, shows that although it may seem rational to believe that the delisting of obsolescent health technology will have negative financial or professional impacts on individuals, in many cases more effective treatments can result in unanticipated benefits for professionals.

## 6 INTERMITTENT POSITIVE PRESSURE BREATHING: A CASE STUDY

The case of IPPB illustrates aspects of health technology obsolescence and the wasteful use of technologies. The protracted scientific debates among interest groups (for example, doctors, suppliers, and engineers) seem to be the norm in the decommissioning of health care processes. Therefore, the case of IPPB is an example of how the proposed model for the systematic delisting of health care technologies might evolve. Despite this, IPPB cannot be an all-encompassing illustration of the decommissioning of outdated health care technologies.<sup>28</sup> Some might argue that IPPB has not become obsolete, and it is arguable whether it should ever have been used as a respiratory assistance device for aerosol delivery and treatment. Notwithstanding this argument, the solutions to technological obsolescence and waste must include a systematic approach to reassessment.

The clinic-based technique of artificial respiration that was developed in the 1950s by H. C. A. Lassen and Bjørn Ibsen rapidly gained worldwide acceptance. Up to this time, assisted breathing was based on the creation of a negative intrathoracic pressure.<sup>28</sup> By the mid-1960s, positive pressure (external) respiration was introduced into anesthesia, emergency departments, and intensive care. Positive-pressure ventilators became the standard of treatment of poliomyelitis, drug poisoning, tetanus, and other causes of respiratory failure.<sup>28</sup>

The concept of artificial respiration using IPPB had developed during World War II, when similar respirators had been used by bomber pilots during high altitude flights. As a result, post-war physicians embraced IPPB as a cutting-edge medical technology without further scrutiny.<sup>28</sup>

Substantial benefits were anticipated from the use of IPPB, because physicians were prompted by an innovation bias (what is new is perceived as being better). The introduction of respirators — which occurred parallel to the diagnoses of a new poliomyelitis epidemic — impressed many physicians. During the immediate post-war period, clinical studies suggested that IPPB was helpful.<sup>28</sup>

As a result, IPPB was often used for a variety of conditions. High-end technological apparatuses appeared with an integrated IPPB function in many intensive care unit respirators — further suggesting increased use because of its presence. Until the 1970s, IPPB was “one of the most common respiratory procedures in American hospitals.”<sup>28</sup>

Nevertheless, criticisms had been present since 1953, when the efficacy of treating emphysema was questioned.<sup>28</sup> The evidence from studies on chronic obstructive pulmonary disease, asthma, or post-operative atelectases began to accumulate. Such evidence not only suggested the ineffectiveness of IPPB but also indicated it to be potentially dangerous.<sup>29</sup>

As the limitations of IPPB became noticeable, most researchers and physicians stopped short of abandoning the technique. Instead, many defended the position of limited obsolescence or focused use in which IPPB could still be a therapeutic option when other approaches failed.<sup>28-31</sup>

The use of IPPB as a focused technology could not be dismissed as being fully obsolete in 1958, in 1968, or in 1988. Although criticisms became widespread, data were lacking. Due to the epistemic belief systems of physicians, the use of IPPB was sustained. These physicians were being influenced by the progress in mechanical ventilation and artificial respiration.<sup>28-31</sup>

This situation seems to hold true for other cases. For example, it took almost 25 years from the first recognition of adverse events to the decommissioning of thalidomide. It was 50 years after the introduction of hormone-based drugs, third-generation antibiotics, and cleansing gels when radiation-based (x-ray) therapy for acne was abandoned.<sup>12,16</sup>

Physicians who hold strong perspectives about continuance are reluctant to dismiss outmoded devices and procedures even during the life cycle stage of spare replenishment and change (Figure 1). This is aligned with sociological perspectives about instances of belief bias, thought styles in research, and medical continuance being driving forces in scientific applications. Also, training and the hierarchical structures in clinical settings are factors in the extended use of technologies.<sup>18,28-31</sup>

Other more circumstantial factors triggered the use of IPPB to continue; for example, marketing, availability of the technology, low investment costs, and a vested interest. Although the cost of primary acquisition of IPPB technology was comparatively low, the operating costs generated from the volume of procedures and its gross profitability resulted in large monetary expenditures by health care payers.<sup>31</sup> Nonetheless, questions about health care costs did not increase the pressure for cessation of use. The protracted process of obsolescence must be explained in terms of social, epistemic, and disciplinary factors. Moreover, the opinions of physicians and other health care workers must be taken into account, particularly given the health expenditure increases during the 1980s.<sup>32</sup>

After almost three decades, the evaluation process by which IPPB was abandoned for the treatment of chronic obstructive pulmonary disease and post-operative atelectases was undertaken. The results of studies and meta-analyses from the National Heart, Lung, and Blood Institute in Bethesda, Maryland were used to settle the dispute.<sup>29-32</sup> This initiated changes in certain reimbursement policies in the US.<sup>28-32</sup> Hospitals started to decommission IPPB therapy. Regional health plans (other than the federal Medicare and Medicaid plans) stopped their earlier reimbursement practices for this technology.<sup>28-32</sup>

The most recent practice guidelines of the American Association for Respiratory Care propagate some of the underlying uncertainties. “*A caveat, however, is that IPPB is not the therapy of first choice for delivering aerosol or a method of lung hyperinflation to be used in spontaneously breathing patients when other less expensive therapies can reliably meet the clinical objectives prescribed for the patient.*”<sup>33</sup> This statement shows that a full-scale decommissioning process has not occurred. The American Association for Respiratory Care, however, has taken a position that it might well have taken earlier.

## 7 BEST PRACTICES: INDUSTRY AND OTHER COUNTRIES

### 7.1 Information Technology Industry

Although the obsolescence of health technologies has been an issue for some time, discussions and publications on this topic are rare. Other industries, however, have had experience in dealing

with technological obsolescence. For example, information technology-based businesses are concerned about advancing newer technologies and retiring former technologies, because software and hardware become obsolete rapidly.

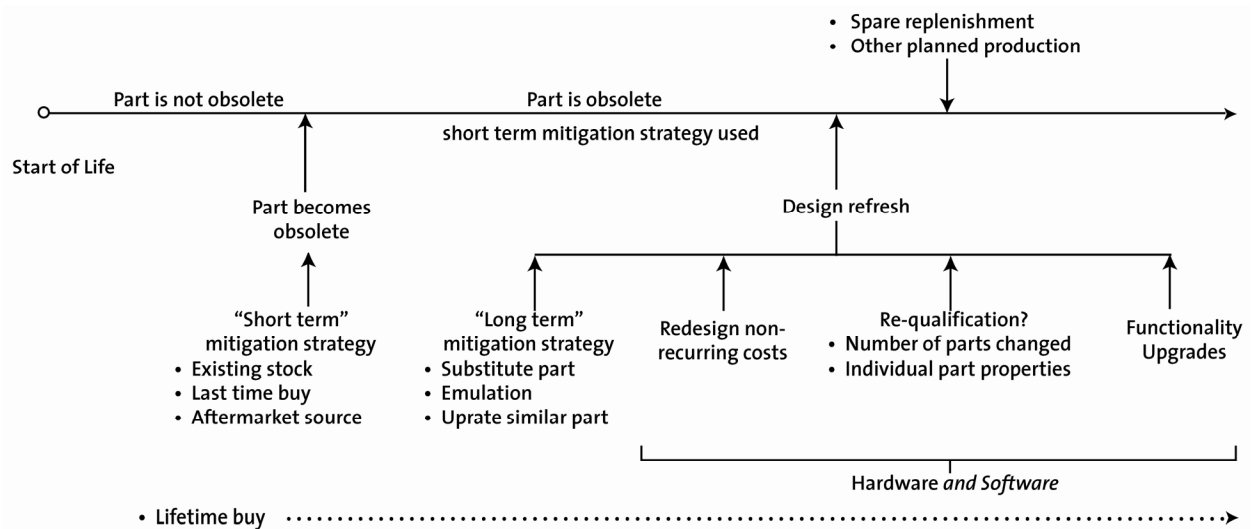
Singh and Sandborn report that many sectors encounter difficulties in adopting and retiring technologies; for example, traffic systems, aeronautics, air traffic control, industrial equipment, and medical technologies:

These product sectors often ‘lag’ the technology wave because of the high costs and/or long times associated with technology insertion and design refresh. Many of these product sectors involve ‘safety critical’ systems where lengthy and expensive qualification/certification cycles may be required even for minor design changes and where systems are fielded (and must be maintained) for long periods of time (often 20 years or more). Many of these product sectors also share the common attribute of being ‘sustainment-dominated;’ i.e., their long-term sustainment (life cycle) costs exceed the original procurement costs for the system.... A significant problem facing many ‘high-tech’ sustainment-dominated systems is technology obsolescence, and no technology typifies the problem more than electronic part obsolescence, where electronic parts refers to integrated circuits and discrete passive components.<sup>4</sup>

One challenge that all industries share is design refresh, which relates to the processes of examining, implementing, and decommissioning health technologies.<sup>4</sup> Questions about the timing of reassessment and the actions that should be undertaken during reassessments are of shared importance to industry. The literature suggests that the dominant issue is not determining when it is necessary for a reassessment or the contents of a reassessment but discovering the optimum timing, resource allocation, and policy structures for this task.

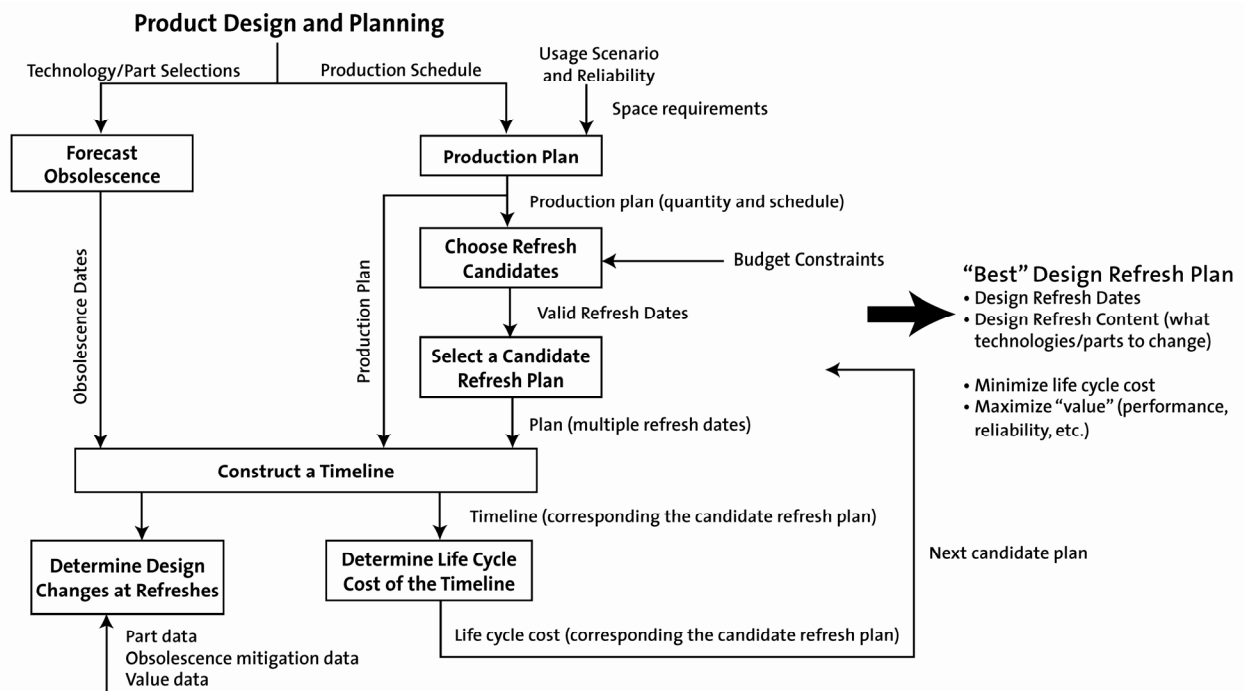
In health technology, decommissioning the obsolete seems to occur only when a sufficient problem or issue is obvious. Most approaches to obsolescence are reactive instead of being proactive. Moving to a more proactive model requires the use of horizon scanning, which is known as “obsolescence forecasting” in the information technology industry.<sup>4</sup> Obsolescence forecasting focuses on tracking components and their availability in the future, predicting the chances that a component may become obsolete, and creating an action plan to be implemented when the parts become obsolete.<sup>4</sup> Adapting this technique in an approach to decommissioning obsolete health technologies would involve investigating which technologies are most likely to become obsolete, when to reassess, and what plans are needed for reduced use and decommissioning.

**Figure 1: Life Cycle of a Technology**



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**Figure 2: Design Refresh Plan**



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Figures 1 and 2 inform the creation of our proposed model for health technology reassessment and obsolescence. Figure 1 focuses on where reassessment should occur, what actions are needed, and the timeline. Figure 2 shows a reassessment plan and inputs that inform the outcomes.

## **7.2 Other Countries**

Several key informants revealed international activities and best practices in health technology obsolescence and wasteful technologies. In general and at national levels, countries have begun to understand the role that reassessment and obsolescence play in health systems.

### **7.2.1 UK**

The UK, through the National Institute for Health and Clinical Excellence (NICE), is the country that is most advanced in the establishment of a disinvestment process. NICE does not have a separate body to handle disinvestment. Instead, it has tried to include disinvestment in the program of technology assessments.<sup>24</sup> NICE has a relationship with the Cochrane Centre, which sends summaries of the Cochrane Reviews of newer health technologies. Specific guidelines are created to outline the focused or constrained use of those technologies that are shown to be cost-ineffective at the time of introduction. NICE has faced criticism from a government house committee for not engaging systematically in disinvestment.<sup>24</sup> NICE members explain why they do not have a formal disinvestment program by stating that this is handled in the guidelines program, where they often identify interventions that the National Health Service should stop. During optimal practice reviews of all the guidelines that have been issued, recommendations are made regarding when interventions should be stopped, reduced, or focused in use. These guidelines are republished to help inform the best practices of health care professionals.<sup>24</sup>

### **7.2.2 Australia**

At a national level, Australia could be comparable to Canada in its examination of obsolescence and the wasteful use of health technologies. Independent researchers and opinion leaders in states such as South Australia have published papers on the need for disinvestment, and there have been stakeholder interviews regarding the issues of disinvestment.<sup>23</sup> As in Canada, most if not all targeted disinvestment practices in Australia have been related to safety concerns about medical devices, techniques, and pharmaceuticals. Mechanisms for targeted disinvestment and the delisting of inefficient or cost-ineffective technologies have been developed. Some disinvestments are pending.<sup>25</sup>

### **7.2.3 New Zealand**

New Zealand does not have a formal process for the decommissioning of obsolescent technologies, but it has one for the delisting of obsolescent pharmaceuticals. The Pharmaceutical Management Agency (PHARMAC)<sup>34</sup> is the government body that evaluates the clinical effectiveness and cost-effectiveness of prescription drugs, negotiates prices, and procures pharmaceuticals, which are then distributed to pharmacies throughout New Zealand.<sup>34</sup> The process of evaluating and re-evaluating pharmaceuticals includes options for positive and

negative assessments. Specific mechanisms for the delisting of obsolescent pharmaceuticals are assumed to be in place.

#### **7.2.4 Spain**

Several technologies have been evaluated for obsolescence by Spain, including anti-TNF in sepsis and high-frequency ventilation.<sup>35</sup> Something that has arisen from this work and that has become apparent during this review is the realization that although a technology (device, drug, procedure, model of care) may not be obsolete, one or more indications for its use may be considered obsolete.

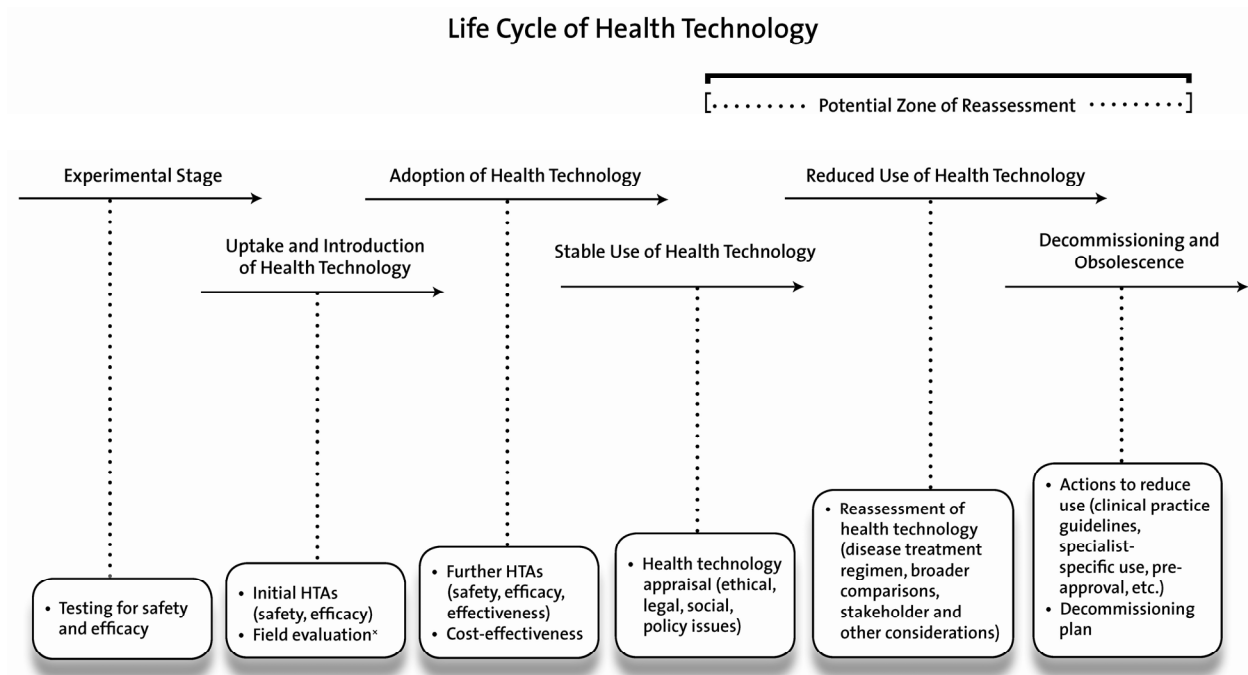
## **8 TOWARD A POLICY FRAMEWORK**

### **8.1 A Proposed Model**

One approach to health technology obsolescence and waste is the creation of a new model for assessing the health technology life cycle and its management. This model could be a modification of present models to include additional considerations for re-assessments, additional mechanisms for the safe decommissioning of obsolete technologies, or the creation of limitations of use.<sup>23,26,36,37</sup> The model would be used not only to identify and delist those obsolete health care technologies in use, but also to assess technologies so that considerations for the safe decommissioning of technologies would be included from the outset. In this iterative process, reassessments would be a necessary component of a technology's life cycle<sup>9,10,12,14</sup>

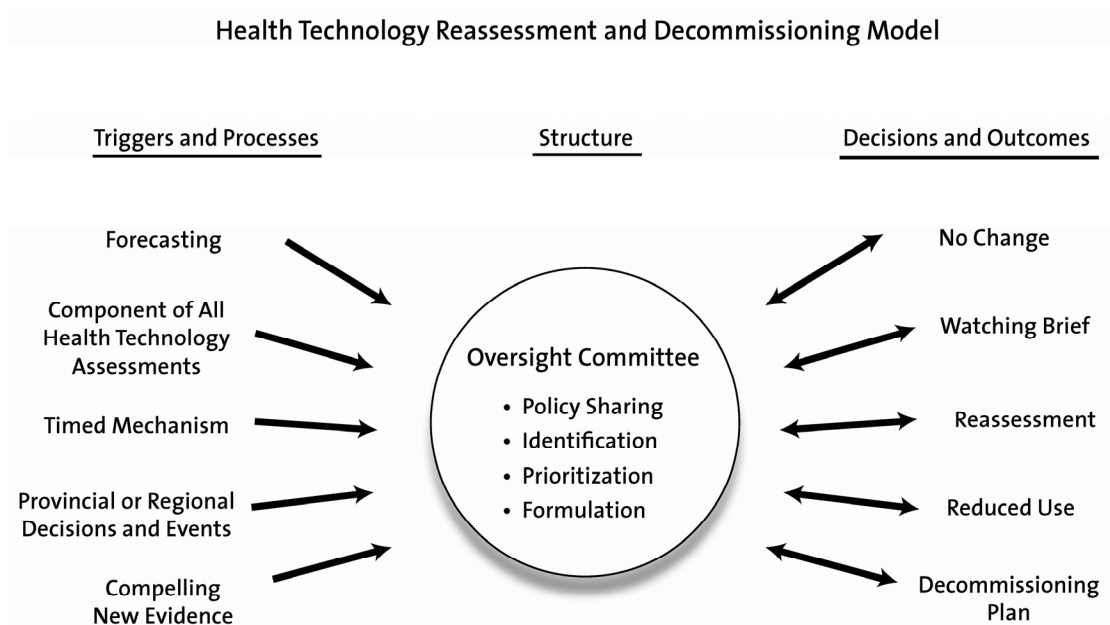
Figure 3 shows where reassessment would fit in the multi-faceted life cycle of a health technology. Figure 4 illustrates the oversight committee, triggers, and possible outcomes in a reassessment and decommissioning model.

**Figure 3: Health Technology Life Cycle and (Re)Assessment**



HTA = health technology assessment.  
 \*Field evaluation may occur at multiple points.

**Figure 4: Reassessment and Decommissioning Model, with Oversight Committee, Triggers, and Possible Outcomes**



## 8.2 Structures, Processes, and Outcomes

### 8.2.1 Structures

Following Donabedian’s framework for the evaluation of medical care, which prescribes an assessment of outcomes, processes, and settings, and informed by Singh and Sandborn’s approach to Design Refresh, a model for the management of obsolescence of health technologies, including a description of structures, processes, and outcomes, is proposed.<sup>4,38</sup>

An oversight body is crucial in the implementation and success of decommissioning and disinvestment policies. The oversight body would engage in a deliberative process to develop and manage a standard approach to transitioning health technologies from stable use to reduced use or full-scale decommissioning (Figure 4). Inputs to decision-making may come from Health Canada, provinces, territories, an expert panel, or industry. New evidence or an unexpected event may prompt attention, such as the recognition of obsolete air conditioning systems as sources of *Legionella* in hospital intensive care units. We are not necessarily proposing that new bodies be created — it would be preferred if such oversight arose from existing entities that can assume this role.

An oversight body for health technology reassessment is needed to represent knowledge sharing and pan-Canadian or multi-provincial interests. The provinces are responsible for health care delivery. Hence, they are central in the introduction, use, and decommissioning of health technologies. A provincial oversight structure that uses deliberative processes and standard approaches is needed. The policy on health technology would include provisions for reassessment and decommissioning that are coordinated to achieve provincial health goals and intentions and would be based on the work of the pan-Canadian body.

### 8.2.2 Processes

The oversight body would require the development and implementation of identification and priority-setting processes for technologies that are to be considered for potential reassessment. This activity would align with other knowledge-sharing and policy harmonization efforts.

The triggers of this process can be prompts, events, or evidence that create for the oversight body a line of inquiry regarding a health technology. Triggers may be forecasted, activated, or timed (Table 3).

| Table 3: Triggers for Reassessment  |
|---|
| Obsolescence forecasting of health technologies   |
| Reassessment of related or adjacent technologies activated by assessment or adoption of new health technologies |
| Provincial and regional requests or decisions based on experience and events                                    |
| New evidence on safety, efficacy, or cost-effectiveness   |
| Timed mechanism (for example, 5 years) beyond approval or introduction  |

A timed mechanism would entail an agreement that in the years after approval or introduction of a new health technology there would be a review to investigate whether focused or reduced use should be considered or relaxed. The timing of the trigger could be fixed (for example, five years) or flexible and determined at the time of approval or introduction.

Current assessments take into account the safety, efficacy, and cost-effectiveness of the technology; and ethical, legal, social, and policy issues.<sup>3,9-13</sup> With the proposed process, assessments must include expanded contextual analyses that determine how a new technology can affect a treatment regimen and stakeholders.

In Australia,<sup>39</sup> with the assessment and introduction of new technology, a trigger occurs, and a line of inquiry by the oversight body is directed at the reassessment of related and adjacent technologies to ascertain whether they are candidates for reduced use or decommissioning. Does the new technology cause another technology to become less relevant? Does it stake a claim on a facet of treatment or diagnosis so that another health care technology can be relegated to more limited use or indications? This trigger may prompt health technology agencies to act at regional or provincial levels. A Canadian approach to reassessment is needed to align the roles of several bodies, including the Policy Forum, a Canadian group of policy-makers who are responsible for identifying areas of common policy interest, sharing information, and collaborating on initiatives in the use of health technologies.

Reassessments can be designed and performed in a similar way as HTAs, even though additional considerations need to be addressed. The delisting of obsolete technology is not the opposite of adoption.<sup>22,36</sup> Obsolescence can occur in the context of an indication, treatment, or clinical situation.<sup>9,14,20</sup> Accordingly, technologies must be assessed in terms of their life cycle not only as independent products but also as products that are used with other technologies and in care plans. This type of contextual analysis will facilitate the identification, reduced use, or delisting of technologies. In addition, the reassessment process can be used to classify a technology as being obsolete, overused, misused, or appropriately used. As we have learned from the experiences at NICE and in Spain, technologies may not be entirely obsolete when some of the indications for use are obsolete. As a result, best-practice protocols should be created for interventions that have valid and limited indications (for example, hysterectomies). These are best formulated through evidence-informed clinical consensus and deliberations by expert panels.

### **8.2.3 Outcomes**

The intended outcome of the reassessment process is to improve the safety, efficacy, and cost-effectiveness of treatments. Accordingly, the oversight body may not alter the use of a technology, but it has to maintain a watchful eye as experience and evidence accumulate. A decision may be made for reduced or focused use, which is likely to be more common than decommissioning and abandonment.

## **8.3 Other Considerations and Challenges**

There may be an optimal time for reassessments and for obsolescence analysis. Carlaw describes optimal obsolescence, which involves decision-making for reassessing and changing capital systems.<sup>36</sup> Optimal timing is based on the context of a technology. Some ineffective or

inefficient technologies remain because there are no other options. In this case, optimal reassessment may occur as soon as newer treatments or technologies become available.<sup>36</sup> Furthermore, because innovation in technologies does not occur linearly but in cycles, accommodations need to be made for rapid technological change that stimulates reassessments and the possible decommissioning of several health technologies at once; for example, devices, drugs, and practices.

The decommissioning of health care technologies involves the identification of technologies that are obsolescent, a priority-setting process to choose among the examples, the collection of enough evidence to support decommissioning, the vested interests that some groups may have in keeping the technologies, payment of the costs of retraining and increasing competence, and cessation of evolutionary dead ends. Another factor is the variability in insured services and purchased technologies across Canada and the multi-jurisdictional perspectives of provinces and territories.

Obsolescent health care technologies can be appropriately identified by expert panels, such as specialist and professional groups who have direct knowledge of drugs, devices, and models of care.<sup>9,25</sup> These groups comprise practitioners who have the experience that is needed to identify which technologies are effective and which have diminishing value. Successful projects, such as Blue Cross and Blue Shield's Necessity Project (US) and the Canadian Task Force on the Periodic Health Examination, used this model.<sup>9,10,12</sup> The additional advantage of using expert panels is that limiting the indications for use of technologies and delisting technologies is more acceptable if the evidence and impetus come from practitioners instead of from managers.

Many technologies have been identified as being overused or misused, but there has been an inadequate response to this problem (Table 2). Even though waste is not obsolescence, the approaches to identification, prioritization, and management do not necessarily differ. For example, hysterectomies and hormone therapy for healthy menopausal women<sup>12,15,21</sup> are being overused in North America.<sup>12,15,21</sup> The use of hysterectomies is not obsolete, but some of the current indications in practice are.

Studies show that bridging the gap between what we know and what we practice remains elusive.<sup>3,10,11,18,20</sup> The plausible way forward seems to be to constrain the use of, or delist, those technologies that evidence shows to be obsolescent or limit them to situations where they are necessary. Although this seems to be a daunting task, the creation of specific protocols by expert panels should help in physician compliance and could be supported by incentives; for example, payment models that are conditional on conformance to best practices or outcomes achieved.

One issue in the delisting of obsolescent health care technology is recognizing that many groups have a stake in retaining these technologies. Disincentives to the delisting of technology may be financial or intellectual.<sup>16,18,23,28</sup> Physicians, for example, may perceive disinvestment as infringements on their authority and autonomy, and they may be concerned about the impact on incomes. The delisting of certain procedures or technologies may seem to be economically detrimental to a department, but in most cases it is not, because newer technologies are given a chance to fill the void. When IPPB was considered to be obsolete and was being de-insured and delisted, there was concern that this would lead to the shutting down of or a limiting of the scope

in respiratory departments at many hospitals.<sup>16,21</sup> In reality, the employee base and fiscal expenditures for respiratory departments grew across the United States as newer solutions were more quickly diffused.<sup>16,21</sup> The delisting of obsolete technology does not necessarily lead to the reduction of costs resulting from the layoff of employees or to an infringement on the autonomy of physicians, nurses, and other health care professionals. Instead, it is about patient well-being and the diffusion of safer, more efficacious, and more cost-effective technologies, and there will be additional costs for retraining and gaining competence in using the new technology.

It would be logical to assume that much of the resistance to the decommissioning of obsolete technology originates with the device users, yet health care administrators can also pose an impediment. The creation of safer, more effective treatments, however, can strengthen, rather than threaten, organizational hierarchies and personal interests.<sup>9</sup>

Other issues seem to complicate reassessment and disinvestments. After reviewing the older interventions that many practitioners are using, there do not seem to be clear conclusions. In most cases, the literature about older interventions is insufficient to lead to conclusions. As a result, without the resources that are necessary for further investigations into older technology, a failure due to lack of evidence could be predicted. Moreover, there is a fear that if some interventions were stopped, more costly interventions would take their place. Therefore, during the reassessment process, it would be important to consider the ramifications of decommissioning a technology.

The issue of health care technology obsolescence is complicated by jurisdictional considerations. What is used or insured in one province or territory may not necessarily be so in another. To handle multi-jurisdictional interests and provide opportunities for knowledge exchange and collaborative actions, a policy oversight body is needed. These challenges must be met in any plan that is aimed at reducing or discontinuing the use of technologies. Change management techniques should be a central component of any plan for reassessment and disinvestment.

## **9 CONCLUSION**

Obsolescence in health technology is an issue that needs to be addressed, not only to contain costs but also to increase the safety, efficacy, comparative effectiveness, and cost-effectiveness of health care that is delivered to patients. By shifting paradigms from the screening of prospective technologies to the examination and reassessment of the product life cycle of all technologies, a tentative equilibrium can be reached in the flow of health care technology. An examination of this equilibrium will reveal challenges such as differentiating between complementary versus substitute treatment options; understanding the medical necessity for, and the appropriateness of, certain tests and therapies; and creating specific mechanisms for reassessments and the subsequent decommissioning of certain health care technologies.

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