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Influence of health technology assessment and its measurement

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Influence of health technology assessment and its measurement

Abstract

OBJECTIVES: The aim of this study was to obtain information on methods used to measure health technology assessment (HTA) influence, decisions that were influenced, and outcomes linked to HTA.

METHODS: Electronic databases were used to locate studies in which HTA influence had been demonstrated. Inclusion criteria were studies that reliably reported consideration by decision makers of HTA findings; comparative studies of technology use before and after HTA; and details of changes in policy, health outcomes, or research that could be credibly linked to an HTA. **RESULTS:** Fifty-one studies were selected for review. Settings were national (24), regional (12), both national and regional (3) hospitals (9), and multinational (3). The most common approach to appraisal of influence was review of policy or administrative decisions following HTA recommendations (51 percent). Eighteen studies (35 percent) reported interview or survey findings, thirteen (26 percent) reviewed administrative data, and six considered the influence of primary studies. Of 142 decisions informed by HTA, the most common types were on routine clinical practice (67 percent of studies), coverage (63 percent), and program operation (37 percent). The most frequent indications of HTA influence were on decisions related to resource allocation (59 percent), change in practice pattern (31 percent), and incorporation of HTA details in reference material (18 percent). Few publications assessed the contribution of HTA to changing patient outcomes. **CONCLUSIONS:** The literature on HTA influence remains limited, with little on longer term effects on practice and outcomes. The reviewed publications indicated how HTA is being used in different settings and approaches to measuring its influence that might be more widely applied, such as surveys and monitoring administrative data.

Keywords

measurement, technology, its, health, influence, assessment

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Abstract

Objectives: To obtain information on methods used to measure HTA influence, decisions that were influenced, and outcomes linked to HTA.

Methods: Electronic data bases were used to locate studies in which HTA influence had been demonstrated. Inclusion criteria were studies that reliably reported consideration by decision-makers of HTA findings; comparative studies of technology use before and after HTA; and details of changes in policy, health outcomes or research that could be credibly linked to an HTA.

Results: 51 studies were selected for review. Settings were national (24), regional (12), both national and regional (3), hospitals (9) and multinational (3). The most common approach to appraisal of influence was review of policy or administrative decisions following HTA recommendations (51%). Eighteen studies (35%) reported interview or survey findings, 13 (26%) reviewed administrative data and six considered the influence of primary studies. Of 142 decisions informed by HTA the most common types were on routine clinical practice (67% of studies), coverage (63%), and program operation (37%). Most frequent indications of HTA influence were on decisions related to resource allocation (59%) change in practice pattern (31%) and incorporation of HTA details in reference material (18%). Few publications assessed the contribution of HTA to changing patient outcomes.

Conclusions: The literature on HTA influence remains limited, with little on longer term effects on practice and outcomes. The reviewed publications indicated how HTA is being used in different settings and approaches to measuring its influence that might be more widely applied, such as surveys and monitoring administrative data.

Keywords: Influence, impact, decision-making, health technology assessment

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Health technology assessment is used to inform decisions relating to health care systems. The effectiveness of an HTA program will depend on its influence - the extent to which information provided in its publications has had an effect on decision makers and in what ways. In this paper, HTA influence is considered to be any action or activity that can be credibly linked to information provided to a decision maker by an assessment [1]. HTA influence is used rather than “HTA impact”, as representing a more realistic indication of the place of HTA in decision-making.

Information on the influence of HTA reports is a guide to the effectiveness of an assessment program. Such information is useful in reporting to funders of HTA programs, in quality assurance processes, and in contributing to global indications of HTA achievements. In principle, there will be interest in the influence of HTA on policy and administrative decisions, subsequent administrative action, delivery of health care and on health status [1]. Much of the focus on HTA influence has been on the first of these. Subsequent administrative action is dependent on the availability of effective machinery and the willingness of the decision maker to make use of it. Influence of an HTA report on subsequent action and outcomes within a health care system depends on the actions of many individuals and organizations [1].

There is still relatively little information available on the influence of HTA on health care decisions and their outcomes. Also, there is limited detail available on methods used to assess HTA influence and the experience of HTA programs in applying such approaches. A review by Gerhardus and Dintsios concluded there was little experience with study designs or methods that allow a valid assessment of the impact of HTA reports on the decision making process. Only limited conclusions related to the impact of HTA reports could be drawn [2].

A review of policies and processes for the introduction of new interventional procedures into clinical practice identified seven studies that described outcomes of policies [3]. The results showed that while the safety, efficacy and clinical and cost-effectiveness of new health technologies are important considerations in the decision-making process, a number of other factors also play an important role. Decisions were never based solely on the findings of HTAs. Niessen et al. [4] reported that 30 studies, including some on HTAs, found that use of economic evidence had a “substantial” impact on health care policy making; 27 studies emphasized at least one other criterion. A further 11 studies found only a limited impact and two studies showed no impact.

The International Network of Agencies for Health Technology Assessment (INAHTA) had obtained information on HTA influence from its members but had not reviewed the available literature. The network decided in 2012 that a working group would undertake a systematic review of reports on HTA influence and its measurement. Five groups of either two or three reviewers were formed by working group members to share the tasks of abstract selection and data extraction. The Swedish Council on Technology Assessment in Health Care (SBU) undertook the literature review and provided project support.

A report on the review is available on the INAHTA website [5]. For this article on the review, the literature search was updated and additional publications included. Further details were provided on the derivation of the categories used in reporting the review findings, and an additional presentation linking details of technologies that were assessed with indicators of HTA influence. Material in the tables was updated to reflect data from the additional studies and include percentages.

The objectives of the systematic review were to obtain information on the influence of HTAs on health care decisions and their outcomes, and on the methods used to measure such influence.

METHODS

A protocol for the review was prepared by members of the working group. Broad inclusion criteria were specified covering studies reporting consideration of HTA findings, and changes in policy, health technology use, health outcomes, or increased level of research.

Published literature was identified using PubMed, Embase, Cinahl , Cochrane Library, PsychInfo, NHSeed, HTA database, DARE, NHS Evidence, and the Swedish HTA database. The searches were supplemented by hand searching the bibliographies of selected papers and through contacts with HTA and other agencies. Publication dates were 2000 – August 2014, subsequently extended to November 2015. There were no language restrictions. Search terms included Technology Assessment, Biomedical, HTA, systematic review, evidence-informed, impact,

influence, information dissemination, implement, policy making, health policy and decision making. Further details of the literature search strategy are available in the INAHTA report on the project [5].

Inclusion criteria were studies that reliably reported consideration by decision-makers of HTA findings and/or recommendations; comparative studies that included relevant measures related to use of a health technology before and after dissemination of an HTA; and studies that reported changes in one or more features that could be credibly linked to information provided by an HTA. Those features were policy related to a health technology, use of a health technology in a health care system, relevant health outcomes associated with use of a health technology, and an increased level of research or initiation of research. Expert opinion, correspondence, commentaries and duplicate publications on the same study were excluded.

A data extraction form was developed, which included lists on approaches to assessing influence, types of decision, indications of HTA influence and opinions on influence used in previous INAHTA publications [1, 6]. The form also included five indicators of study quality that were specified in the protocol. These had some relevance to quality but were also related to the scope of a study (Supplementary List 1). Quality ratings were given by the number of indicators that applied to each study, with scores from 1 to 5.

Each reviewer group was allocated a list of identified publications for initial screening using titles, abstracts and keywords. Any citations considered relevant or for which there was uncertainty were retained at that stage and the full papers obtained. The identified publications

were considered independently by the reviewer groups and selected if they met the inclusion criteria. Differences between individuals within the reviewer groups were discussed and resolved by consensus.

Information extracted from the selected publications by the reviewer groups included the study setting, health technologies that were assessed, types of decision informed by the assessment, the approach used to assess HTA influence, main indications of influence, measures and/or opinion on influence, and non-HTA influences on outcomes. Any disagreements were resolved through discussion. For publications covering many HTA reports, the technologies were listed but other elements in the data extraction were based on the summary information that was provided, rather than considering each recommendation and its influence individually.

In some cases, the authors' opinion on level of HTA influence was reported, or was apparent from details presented in the reviewed publication. For other publications, a judgement on the level of influence was made by the reviewers. Level of influence was recorded on a four point scale used in previous INAHTA projects (major influence on decisions, some input to decisions, some consideration of the assessment, minimal influence) [6].

RESULTS

After removal of duplicates, 4,767 publications were identified by the literature search. An overview of publication selection is shown in Supplementary Figure 1. Adjustments to initial selections were made through exclusion of earlier publications from series of reports on the

same topic, papers that were not related to influence of HTA, and publications where there was insufficient information to provide a clear indication of influence. Fifty five publications covering 51 studies were selected for review. Reports on measurement of HTA influence were obtained from 19 countries – Argentina, Australia, Austria, Belgium, Canada, France, Finland, Germany, Italy, Malaysia, the Netherlands, the PRC, Poland, Spain, Sweden, Switzerland, Thailand, the UK and the USA. Three publications provided information on more than one country - a report on EU countries, a survey with details from Australia, Brazil, Canada, Spain and the USA, and a survey of Latin American and Caribbean countries. Study settings were national (24), regional (12), both national and regional (3), multinational (3), and hospitals (9).

Approaches taken to appraisal of HTA influence are shown in Table 1. Several studies used more than one approach. The most common was review of policy, and of acceptance of HTA recommendations (in 51% of studies). Eighteen studies (36%) used surveys or interviews with decision makers, 13 (26%) reviewed or analysed administrative data, and six (12%) considered the influence of primary studies.

Types of decisions informed by the HTAs are shown in Table 2. Decisions related to routine practice (in 67% of studies), coverage (63%), program operation (37%) and capital funding (35%) were the most common categories. Table 3 shows the indications of HTA influence that were noted during data extraction. Several studies showed more than one influence on decisions. Influence on decisions involving resource allocation was the most frequent indication (in 59% of studies). There were also a number of indications related to effects on practice (31%), and incorporation of HTA details into reference material such as guidelines and program management manuals (18%).

Opinion from 21 (41%) of the studies was that HTA had had a major influence on decisions. In 13 studies (25%) HTA had provided some input to decisions, with 6 (12%) there was some consideration of the assessment and in 3 studies there was minimal influence. In the other 8 studies, details given indicated that HTA influence on decisions had varied for different technologies (major influence 80 (54%), input to decisions 24 (16%), consideration of the assessment 36 (24%), minimal 9 (6%)). Some of the 'minimal' ratings were associated with the early stages of HTA programs. Quality ratings were high (5 or 4) for 27 studies (53%). Seventeen (33%) had a rating of 3 and seven a rating of 2.

Brief details of material in the reviewed publications are shown in Table 4. Assessments on medical devices and surgical procedures informed decisions on coverage and conditions of use for technologies, with consequences for routine practice. The studies on screening technology point to the importance of HTA in providing input to government processes for the development and implementation of national screening programs. HTAs had a major influence on coverage decisions for pharmaceuticals; there were limitations in the influence of negative recommendations on the use of some drugs. The studies also indicated the place and value of rapid assessments and the success of hospital HTA programs in influencing local policy and administrative decisions. Further information is presented in Supplementary Tables 1 and 2.

DISCUSSION

Both positive and negative HTA findings on health technologies were influential. Many related to relatively short-term targets (policy and administrative decisions). Some also covered subsequent administrative action and program planning issues. Gerhardus and Dintsios [2] refer to use of interviews with decision-makers, document analysis, surveys and use of administrative data as methods in the evaluation of HTA

influence. A similar mix of approaches was used by the studies included in this review, and also appraisal of the effects of primary studies. Approaches using review of decisions seemed useful. Some HTA programs had close contact with decision makers, giving opportunities for realistic appraisals.

The reviewed studies provide good examples of the place of HTA in health care decision-making. Information on the influence of assessments can have a role in making a contribution to a broader, global perspective of HTA's achievements and usefulness [1]. There were clear indications of the benefits to both decision-makers and HTA researchers from maintaining regular, appropriate contact at all stages of the HTA process (Supplementary Tables 1 and 2). For decision-makers there are examples of the sorts of decisions and programs that HTA informs. There are some insights into the decision making process, and indications of savings, efficiencies and practice changes linked to HTA findings. There are lessons to be learned from some limitations, both in consideration of HTA advice and in the implementation of decisions.

There were also examples that might be followed more widely on approaches to measuring influences. Valuable information on some longer term influences was obtained through monitoring administrative data and through survey approaches. Primary studies can form a useful part of the HTA process, as shown through indications of changes to practice patterns, relating to the delivery of health care [1].

There was little indication of influence of HTA on the health status of patients, though this was captured to some extent by a review of SBU assessments. Two studies reported use of HTA linked to coverage with evidence development (CED) for consideration of policy decisions at regional or national level. A CED approach was also used with an HTA program that evaluated surgical technologies. Estimates of savings

achieved through use of HTA were found in studies covering hospitals in Montréal and Buenos Aires, and in a study of HTA in Austria which noted contributions to disinvestment decisions.

The literature covering the matters addressed by this review is still quite limited. Few recent studies have considered the influence of HTA in any detail, and there is little on the longer term effects on clinical practice and health outcomes.

There is a progression of possible influence, from the decision maker level with increased knowledge and awareness, to changes in policy and healthcare delivery, up to changes in patient outcomes. Changes to health care and improved health are dependent on the actions of many individuals and organizations. Measuring change across all stages of influence should be considered, as the contribution of the HTA to changes in patient outcomes is not going to occur if these earlier stages of influence have not first been realised.

Detailed appraisal of HTA influence, especially in the longer term, can become a significant research project. Such projects may be resource intensive, and be undertaken only occasionally. Availability of data may be an issue; access to records may need to be negotiated, or surveys of users of health technologies put in place. However, shorter - term evaluation of influence on decision makers may need only modest resources. Essentially it is a question of incorporating approaches to obtaining indications of influence into the routine management of an HTA program [1].

Both assessors and decision makers have important roles and responsibilities in the HTA process. Future studies on HTA influence will be facilitated by good and continuing interaction between these parties. The HTA agency should aim to generate some reaction from decision

makers to the material and advice that have been provided. There should be contact with the decision makers early in the assessment process and while the project is in progress. It is necessary to maintain a dialogue [62].

A monitoring system developed in Québec used telephone interviews with requesters and users to obtain reactions of decision makers to HTA reports and intended action on the technologies that had been assessed [1]. Perceived relevance of recommendations and intention to adopt recommendations can be used as a proxy for influence [62]. The INAHTA impact framework provides a basic approach to collecting information on HTA influence [6]. Approaches based in part on application of the framework have been able to capture details of at least short term influence [41]. Resources for more detailed studies on longer term influence of HTA should preferably be a matter for negotiation between the assessment agency, its governance and decision makers at an early stage.

Further studies would also be facilitated by encouragement for agencies and their clients to give details of both successes and failures of their HTAs in influencing decisions. 'Failures' as well as successes need to be considered and acted on if influence measurement is to be useful for HTA program management, and as feedback to clients. Open provision and wide distribution by HTA programs of information on their influence has been recommended [1].

This systematic review had several limitations. The estimated extent of influence is based on the authors' findings and opinions, or on our to some extent subjective judgements, and should be critically reviewed. We may expect some degree of publication bias towards positive stories, but it is difficult to assess the extent of this. There were restrictions on the dates and scope of the literature search and on the

approach taken to assessment of study quality, to take account of time and resources available to reviewers. On the other hand, the quality appraisal approach that was used touched on some things that are often not considered in a formal fashion. The information presented is largely confined to summaries of details in the selected publications. There was not sufficient time to scan and follow up reference lists of included publications or to carry out citation searching. For example, an overview by Raftery and Powell of the UK Health Technology Assessment programme gives some indications of HTA influence that could be followed up [63]. Nor was it possible to systematically search the grey literature for evaluations of HTA programs and their influence.

POLICY IMPLICATIONS

While there is variation in the influence that HTA reports or programs might have, most of the examples considered here informed decisions on health technologies. All but three of the 51 studies identified successful HTA influence. HTA has been an important input to policy formulation and implementation in many settings. The publications covered by this review have much useful information related to HTA influence including approaches that might be used more often. Some of them had been produced as components of HTA program management [1].

The limited number of studies following change in clinical practice and health outcomes indicates that these areas need much more attention in the future. Quality registers and clinical data bases are growing rapidly around the world and they could be very useful tools for analysing the influence of HTAs.

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Table 1: Approaches taken in assessing HTA influence *

	Number of studies	%
Review of policy, and of acceptance of HTA recommendations [10,12,14,18,21-24,26,28-32,36,38,39,41-46,48,50,51,57,60]	26	51
Questionnaire surveys of decision makers or agencies [20,34,35,47,55,57,58,60,61]	8	16
Qualitative interviews with decision makers [16,33-35,37,38,40,43,45,58]	8	16
Analysis of administrative data [7,9,18,37,52,53,60]	7	14
Review of policy and of administrative data [13,15,17,19,49,58]	6	12
Review of the effects of primary studies [8,27,56-59]	6	12
Qualitative interviews plus review of decisions	2	4

[54,56]

* The numbers following each item denote the references

Table 2: Types of decisions informed by HTA

Types of decision *	Number of studies	%
Influence on routine clinical practice [8,10,12-20,23,24,26,32,33,37,38,40-48, 52-58,60,61]	34	67
Coverage [7,9,10,15-18,21,22,24-26,28,30-32,36-39,40-43,46,47,49-51,54-58,60,61]	32	63
Program operation [9,12,17,18,21,23,25,26,30,31,33,37,38, 40-42,44,48,55,56,60]	19	37
Capital funding [13,16,19-21,27,38,40-45,47,48,50,54,55,61]	18	35
Guideline formulation [7,8,11,13,14,29,34,35,40-42,55,57-61]	14	27
Indications for further research [12,17,38,43,45,47,48,55,57,58,60,61]	12	24
Referral for treatment	6	12

[11,23,28,43,44,54]

Formulary	4	8
[38,43,49,55]		
Other ^a	3	6

a) Other decisions: Equipment sales [19], Legislation to regulate program [23], Strategy planning process [34, 35]

Table 3: Indications of HTA influence

Indication *	Number of studies	%
Acceptance of recommendations, linked to resource allocation	30	59
[7,9-11,13-17,21-25,28,30,32,36,37,39-43,45-51,54]		
Change in practice pattern	16	31
[8, 12,13,15,17-20,33,37,52,53,56-58,60]		
Incorporation of HTA details in reference material	9	18
[29,34,35,40-42,47,55,58-60]		
Planning process for program	6	12

[12,13,17,18,30,34,35]		
Influence on research	4	8
[12,17,44,60]		
Acceptance of recommendations, clinical indications	3	6
[44,48,58]		
Influence on other HTA programs [58,61]	2	4
Evaluation of device performance [27]	1	2

Table 4: Details of technologies and HTA influence

<i>Area</i>	<i>Topic</i>	<i>Indicators of HTA influence</i>
Medical devices	Drug-eluting stents	* Available only for high-risk patients with abdominal aortic aneurysm [7]
	Peritoneal drainage catheter	*Availability for persons with recurrent malignant ascites [11]
	Robotic surgery	*Agreement on indications and criteria for treatment [12]
	Cochlear implantation	*Agreement on criteria for treatment [14] Decision not to support bilateral CI for children [15]
	Surgical devices	*Use by a purchasing organization for procurement decisions [27]
Diagnostic services	Preoperative examinations	* Reduction in use of these services [19]
	Pediatric radiology	* Effects of guidelines on practice patterns [8]
	Pharmacogenomics in treatment of H. pylori infection	* Determination that the technology was investigational [28]
Screening technologies	Breast cancer	Acceptance of HTAs by governments, introduction of national programs [17,18]

Prostate cancer	* Recommendations against screening accepted, influence on practice patterns limited by opportunistic testing [17,18]
Maternal screening in pregnancy	* Acceptance of HTAs by governments, introduction of national programs [18,21,23] and a Ministry guideline [29]
Newborn screening	* Introduction and expansion of screening programs [30, 31]. * Coverage processes better when associated with HTA [22]
Abdominal aortic aneurysm screening	* Service funded following HTA [26]

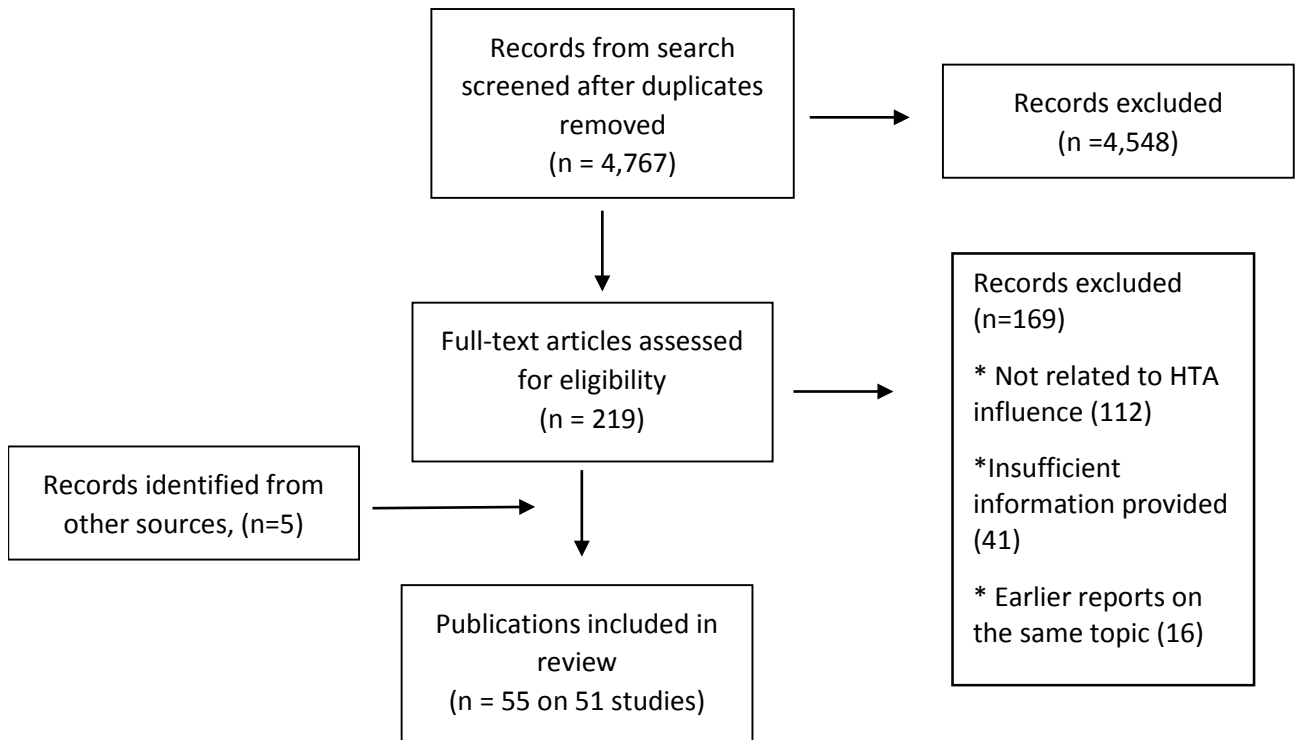
Surgical and other procedures	Disc arthroplasty	* Contributed to a decision on coverage following CED [9]
	Hand transplantation	* Decision not to fund procedure [10]
	Cardiac bypass surgery	* Expansion of open heart surgery services [24]
	Treatment of severe morbid obesity	* Funding decisions on gastric banding and electrical

		stimulation [30]
	Prioritization procedures	* Decisions for cataract surgery, joint replacement [25] bariatric surgery [26]
Respiratory disease	Approaches to management	* Changes in health services and clinical practice [33]
Public health	Tobacco prevention	* HTA program influenced dental professionals [20]
	Planning for facilities and services	* HTAs influenced public health- related decisions [34,35]
National HTA programs	Coverage and other decisions, guidelines and clinical practice	* Acceptance of advice on coverage, disinvestment, guidelines and practice patterns, influence on policy [36-38,46, 56-60]
	Pharmaceutical coverage and use	* Major influence on coverage decisions [49-51] * Changes in the level of use for management of blood pressure, dyspepsia, multiple sclerosis [19] Negative appraisals had little influence on drug use [52,53]
Regional HTA programs	Policy decisions based upon CED studies. Influence on ministry decisions	* Decisions consistent with HTA recommendations [39] * Most HTAs influenced policy or program decisions [41,42]

		HTAs accepted by stakeholders [47]
Hospitals	Decisions in public hospitals	*Informed decisions on surgical technologies [44], new technologies [45, 48], management of pediatric patients [13]
Other topics	Use of rapid HTAs	* Health ministry decisions were consistent with HTA advice [54]. All HTAs had some influence [55].
	Use of HTAs by other jurisdictions	* HTAs from other jurisdictions used to guide decisions [61]

Supplementary Figure 1

Selection of publications



Supplementary List 1: Indications of study quality

Answer the following questions (Yes/No) for each publication selected for review. Score one point for each Yes answer and record the total score (maximum of 5). Higher scores tend to indicate that greater confidence can be placed in the quality and applicability of the study findings.

* Were the findings of the HTA report(s) summarized?

* Was the decision - making process that was influenced by the HTA described or referenced?

* Was the approach used to assess HTA influence described?

* Were outcomes or influence reported?

* Were non – HTA influences considered?

Abbreviations used in Supplementary Tables 1 and 2

AAA: Abdominal aortic aneurysm

ACE: Angiotensin-converting enzyme

BCBS: Blue Cross and Blue Shield

BDM: Bone density measurement

CI: Cochlear implantation

CED: Coverage with evidence development

COPD: Chronic obstructive pulmonary disease

EU: European Community

HSR: Health services research

ICER: Incremental cost-effectiveness ratio

ICU: Intensive care unit

NHS: National Health Service

NICE: National Institute for Health and Care Excellence

OCT: Optical coherence tomography

PCR: Polymerase chain reaction

PPI: Proton - pump inhibitor

PSA: Prostate serum antigen

QALY: Quality-adjusted life year

SBU: Swedish Council on Technology Assessment in Health Care

SMS: Scottish Medicines Consortium

US: Ultrasound

Xpert MTB/RIF: Mycobacterium tuberculosis and rifampicin resistance test

Supplementary Table 1. Publications covering HTAs and small numbers of technologies						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Goeree [7], 2006 Drug-eluting stents	Canada, provincial health system	Coverage, Guideline	Data on introduction and use following HTA & decision maker action	Acceptance of recommendations re availability only for high-risk AAA patients	Major	4
Dunning [8], 2004 Skull X-ray, CT, (paediatric)	England, three hospitals	Guideline, Practice	Sub analysis of prospective cohort study, Monte-Carlo simulation	Guidelines do not increase workload, but move patient management from the observation ward to the radiology department	Some input to decisions	3
Schluessmann [9], 2009 disc arthroplasty	Switzerland, National	Coverage, Program	Details of registry information following decision to use CED	Coverage provided by insurance program	Major	5
Brügger [10], 2014 Hand transplantation	Switzerland, National	Coverage, Practice	Details of a recommendation from an appraisal of the HTA report and subsequent consideration by the national accident insurance committee'	Decision not to fund hand transplantation for ethical reasons, because of considerable side effects, and relatively limited health gains, particularly for unilateral amputees	Major	4
White [11], 2012 peritoneal drainage catheter	England, NHS	Referral, Guideline	Formal decision process linked to HTA findings	Acceptance of recommendation in a Medical Technology Guidance	Some consideration	4

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Ballini [12], 2010 Robotic surgery	Italy, Hospitals in the Emilia-Romagna Region and regional health authority	Program, Practice, Research	Review of decisions following evaluation by multidisciplinary panel that included systematic review, analysis of local context, and identification of indications with promising clinical return.	Agreement on clinical indications for which the robot should not be used and suspension of these by hospitals and surgeons. Agreement on a list of promising clinical indications and for evaluation locally Proposal by local surgeons, for two multicentre clinical trials	Major	3
Demirdjian [13], 2015 18 HTAs	Argentina, national pediatric hospital	Capital funding, Guideline, Program, Practice	Monitoring decisions taken by hospital administrators. Review of administrative data	Acceptance of recommendations on: * albumin solutions - albumin consumption and associated costs reduced by 50% * cochlear implantation - a suitable device substituted for one with unacceptable performance * OCT - equipment was not incorporated * palivizumab – use in high risk patients * PCR – use in high risk patients Not accepted on: * reiki techniques (continued use in pre-operative setting) * procedural sedation program	Major	4
Berrettini [14], 2011 Cochlear implantation (CI)	Italy, National Agency for Regional Healthcare Services, coordinated by Lazio Region	Guideline, Practice	Advice re acceptance of recommendations following systematic review on clinical & economic aspects of CI	Recommendations on criteria for treatment of several patient groups were approved with minimal suggestions by members of a coordinating committee that represented all stakeholders	Some consideration	2

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Kosherbayeva [15], 2014 Bilateral cochlear implantation for children	Kazakhstan, National	Coverage, Practice	Review of decisions by the Ministry of Health following systematic review on clinical aspects of bilateral CI, and analysis of administrative data on hearing services in Kazakhstan.	Ministry of Health decided not to support provision of bilateral CI for deaf children. Action would be taken to procure equipment for early detection of children with hearing loss, and to strengthen rehabilitation services after unilateral CI.	Some input to decisions	4
Vermeulen [16], 2001 Screening – breast cancer, prostate cancer, ultrasound in pregnancy	Belgium, Flemish Preventive Service	Coverage, Capital funding	Interviews with stakeholders and experts, review of policy	Use of technologies did not follow advice from available assessments. Lack of a systematic approach to prevention policy and practice	Minimal	5
Banta [17], 2001 Screening – a) breast cancer, b) prostate cancer c) ultrasound in pregnancy	Netherlands, National	Coverage, Program, Practice, Research	Appraisal of program implementation, data on use of screening tests	a) Mammography – CEA was followed by national screening program for breast cancer b) Recommended against prostate cancer screening –, accepted by government but “quite a lot” of opportunistic screening. Recommendation re future research accepted by ministry & implemented c) Selective use supported, for high risk groups. But 80 -90% pregnancies screened with US	a) & b) Major c) Minimal	5

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Jonsson [18], 2001 Screening – a) breast cancer, b) prostate cancer, c) ultrasound in pregnancy	Swedish public hospital service	Coverage, Program	Decisions and practice patterns followed HTA recommendations	a) Strong influence on screening mammography, rapid increase after publication, all counties offered screening. b) HTA recommendations followed by the county councils, none organised screening programs for prostate cancer. Opportunistic testing thought to be relatively common and increasing in rate. c) Introduction of routine screening was recommended and became routine	Major	4
Britton [19], 2002 a) Preoperative examinations b) Management of moderately elevated blood pressure, c) Prostate cancer screening. d. Bone density measurement e. Neuroleptics as calming therapy for old persons f. Proton pump inhibitors for functional dyspepsia	Sweden - National and local (counties)	Capital d, Practice a, b,c,e,g, Equipment sales d	Decisions/ trends in use of technologies, following HTA recommendations	a) Major decrease in pre- op exams b) Levelling off in increase of ACE inhibitor, calcium channel blocker prescriptions c) Huge increase in PSA test use d) Increase in sales of BDM machines e) Slow decrease in use of antipsychotic drugs, larger in Kronoberg County which made a concerted effort to reduce f) National trend in prescriptions for PP inhibitors unclear, overall cost for anti-dyspepsia drugs 8% less. Decrease in PPI use in Skellefteå County through local drug committee initiative	Minimal : c,d) Some consideration: b) Some input to decisions: e, g) Major: a)	4

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Axelsson [20], 2006 Tobacco prevention	Sweden, Dental hygienists & dentists in Stockholm County	Practice	Questionnaire survey, comparison with previous investigation, reference to SBU report and a guideline	Awareness of guideline reported by 90% hygienists, 66% dentists Information in guideline used by 54% hygienists, 34% dentists 25% of dental professionals reported increased tobacco cessation consultation However, no change in number of patients receiving cessation support or the mean time for these activities	Some input to decisions	5
Stemerding [21], 2001 Maternal screening	Netherlands, national	Coverage, Capital funding, Program	Analysis of medical journals and government reports	Noted control and regulation of serum screening by the political decision-makers, allocation of funding. A counter influence was promotion by the medical community,	Major	5
Fischer [22], 2011 Newborn screening	11 EU countries	Coverage	Association between HTAs and coverage decisions in EU countries 7 decisions with HTA, 15 without	Association between HTA and coverage decision processes was more explicit, inclusive, and transparent than non HTA-related decisions	Some consideration	3
Autti-Ramo [23], 2007 Fetal abnormalities screening	Finland, national	Referral, Program, Practice, Legislation to regulate program	Relationship of decisions to HTA recommendations	HTA provided information on options for optimum screening programs, identified major policy questions that required public discussion. National committee subsequently opened up this discussion	Major	5

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Carlsson [24], 2001 a) Cardiac bypass surgery b) Chiropractic care for back pain	Sweden, national and local HTA initiatives	Coverage, Practice	Review of administrative, policy developments	a). HTA, other reports linked to change in policy and expansion of open heart surgery services b). Results of RCT, including costs, were input to decision by politicians at local level (no difference in cost-effectiveness)	Some input to decisions	a) = 2 b) = 4
Gagnon [25], 2006 a. insulin pump b. prioritization for cataract surgery c. prioritization systems for hip or knee replacement	Spain, hospitals within Catalan Health Regions	Coverage, Program, Practice	Semi-structured interviews, transcripts classified according to theoretical dimensions and contextual factors	Adoption of HTA recommendations depends on a conjunction of factors (institutional, organizational, professional) that is unique to the specific technology assessed.	Some consideration	3
Bergh [26], 2010 a) Bariatric surgery b) Screening for abdominal aortic aneurysm c) Liquid-based cytology d) Auricular acupuncture for drug addiction	Sweden, Västra Götaland County	Coverage b,d, Program a,b, Practice c	Review of HTA use by client organizations, implementation of recommendations	a) Use by local authorities & regions b) Funded and implemented c) Widely recommended for screening d) Coverage denied	Some consideration:- a,c) Some input to decisions: b,d)	2

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Burns [27], 2007 clip appliers, staplers, trocars, suture and needle, endoscopic specimen retrieval device	USA – Surgical practices	Capital funding	Evaluation by surgeons of comparable medical devices in standardized surgical procedures, and use of evaluation findings by a hospital purchasing organization	Products from 8 vendors evaluated and ranked for ergonomics, functionality, performance, clinical acceptability. 1 vendor received consistently higher ratings than the others across all product categories; 2 received consistently low ratings for several product categories. Findings were used by the purchasing organization to select the vendor(s) they wished to contract with	Major	2
BCBS [28], 2008 Pharmacogenomics	USA, National	Coverage, Referral	Review of policy response to assessment	Policy statement that genotyping to determine cytochrome p450 (CYP2C19) genetic polymorphisms is considered investigational for managing the treatment of H. pylori infection. No change in 2011	Major	2
Chen [29], 2009 a) Assisted reproductive technology b) Prenatal diagnosis	PRC, National	Guideline, Practice	Responses to contracted assessments, action by the Ministry of Health	Guidelines issued by the Ministry of Health, based on HTA material	Major	2

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
<p>Borowski [30], 2007; IHE [31], 2015</p> <p>a) Laparoscopic adjustable gastric banding b) Fetal fibronectin assay c) Gastric electrical stimulation d) Newborn cystic fibrosis screening e) Newborn metabolic screening</p>	Canada, Alberta health ministry & health care system	Coverage (b-d), Program (a,b,d,e), Practice (d,e)	Formal decision process linked to HTA findings, review of health ministry decisions	<p>a) To be publicly funded; regions to determine whether they will offer bariatric surgery b) Regions to introduce service and determine best service delivery model. All adopted the service. Expected health system savings were not achieved (reliance on false-positive test results). c) Not funded because of investigational nature d) Introduction of province-wide screening, funding provided e) Expansion of list from 3 to 16 conditions, funding provided</p>	Major	4
<p>Buxton [32], 2006</p> <p>Interferons and glatiramer acetate for multiple sclerosis</p>	UK – England and Wales	Coverage, Practice	Example from review of development of economic evaluation of health technologies in the UK and its impact on decision making	<p>NICE deemed none of the drugs to be cost effective at incremental cost per QALY of £35 000–104 000. Department of Health intervened with scheme that accepted a maximum threshold cost per QALY of £36 000. If the patient’s progress failed to equate with an ICER of £36000 or less the cost of the drug to the NHS would be rebated.</p>	Some input to decisions	2

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Solans-Domènech [33], 2013 a. Exacerbation of COPD, - prognostic factors b) Risk factors predisposing to acute exacerbation of COPD c) Validation of a diagnostic procedure in sleep apnea-hypopnea syndrome, d) Cost-effectiveness of home care in exacerbation episodes of COPD using a respiratory-function unit e) Management of bacterial resistance in the ICU f) Phenotypic characterization of COPD	Spain – Catalan health system	Program Practice	Qualitative study of six projects on respiratory diseases funded between 1996 and 2004. Semi-structured interviews with 15 researchers and 8 healthcare decision-makers	Most participants indicated changes in health services or clinical practice had resulted from research. “The barriers and facilitators identified were mostly organizational (in research management, and clinical and healthcare practice)... Both the expected and achieved impacts enabled the identification of the gaps between what is expected and what is truly achieved.” No specific recommendations for policy makers;	Some input to decisions	3

Supplementary Table 1 (continued)						
Author, Technology	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Bowen 2007 [34], Opinion Leader Research [35], 2003 Draft Economic Development, Waste, Energy, London Plan strategies	UK – City: strategies from the Greater London Authority (GLA)	Guideline, Strategy planning process	Qualitative strategy to evaluate 4 health impact assessments (HIAs) of draft mayoral strategies. Included group discussions, in depth interviews, questionnaires	Increased consultation with public health staff by GLA Wider consultation during development of a strategy Strategies were revised as a result of outputs from HIAs Strategy team reported few barriers to incorporating recommendations into the final strategy document.	Some input to decisions	3

Supplementary Table 2: Publications on HTA programs and larger numbers of technologies						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Mad [36], 2012 25 HTAs + 9 updates	Austria, public health care system	Coverage	Analysis of whether HTA advice to regulate coverage was accepted by the Ministry of Health	HTAs recommended coverage with limitations for 11 interventions and did not recommend for 22. Ministry decided on acceptance in 7 cases, rejection in 18 and changed the status to 'subject to approval' in 7	Major	5
Zechmeister [37], 2012 69 HTAs including 11 full reports	Austria, public health care system	Coverage, Practice, Program management	Analysis of administrative data from hospitals and health insurance funds. Interviews with representatives of administrations and payers	Findings from 9 of 11 full HTAs contributed to decisions by insurance funds and hospital management. Recommendations from 19 of 42 rapid assessments accepted by hospital financing board. Findings from 6 of 7 HTAs contributed to disinvestment decisions which led to savings of more than € 22 million	Some input to decisions	4
Vinck [38], 2013 78 reports including HTAs, HSR, Good Clinical Practice	Belgium - National	Coverage, Capital funding, Formulary, Program, Practice, Research	Review of impact of reports published during 2009-2011. Information from project staff, other contacts, websites, legislation. Direct impact if at least one recommendation was implemented; indirect impact if recommendations featured in debate but were not yet implemented	11 reports with recommendations aimed at health care professionals classified as "not measured" About half of the remaining 67 reports had a direct impact and about one third were currently under discussion In the case of one HTA report a decision was taken that went directly against recommendations	Major	5

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Levin [39], 2011 10 HTAs	Canada, Ontario public health care system	Coverage	Consideration of policy decisions based upon CED studies. Compared decisions with results of studies	In 9 cases decisions were consistent with HTA recommendations, awaiting results for the other HTA	Major	4
a)Turnkey [40], 2002 10 HTAs Hailey [41,42] 2004, 2005 25 HTAs	Canada, Alberta health system	Coverage, Capital funding, Program, Guideline, Practice	a) Qualitative research - interviews with HTA program clients b) Data collected by HTA program using form in part based on INAHTA instrument.	a) Eight of 10 products informed policy and resource allocation decisions. b) Feedback from clients, decisions on HTA recommendations, inclusion of HTA material in documentation	a)Some input to decisions b) 3 HTAs, had major influence, 16 input to decisions, 3 some consideration, 3 minimal	a) 2 b) 5
McGregor [43], 2012 20 technologies	Canada, University Health Centre (five teaching hospitals) within the Québec healthcare system. Local in-hospital HTA unit	Coverage, Capital funding, Formulary, Practice, Research	Evaluation of the extent to which reports have influenced hospital policy decision making and spending. Feedback from individuals responsible for technologies in question	Of 63 policy recommendations, 45 were accepted and incorporated into Health Centre policy. 1 was partially incorporated, 17 were not incorporated into policy.	Major influence on the majority of decisions, some consideration for others	4

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Poulin [44], 2012 Surgical technologies 53 completed applications for support	Canada, Department of Surgery & Surgical Services, Calgary Health Region	Capital funding, Program, Practice,	Retrospective analysis on outcomes of a local HTA program over 5 years Local HTA committee decisions categorised	12 applications approved, 3 approved for a single case on an urgent basis, 21 approved for a restricted number of cases with outcomes review, 14 for research use only, 3 referred to additional review bodies.	Some input to decisions	4
Bodeau-Livinec [45], 2006 13 technologies	France, Hospital network, Paris	Capital funding, Practice, Research	a) Qualitative – semi structured interviews with persons affected by HTA recommendations b) Review of decisions following 13 HTAs	7 Major influence, usually through funding being approved or withheld 3 difficult to distinguish between HTA influence and that of experience gained during supplementary studies 1 Minimal influence , decision contrary to recommendation 2 uncertain due to influence of major external factors	1 Minimal 7 Major 5 Uncertain	5
Gibis [46], 2002 22 technologies	Germany, National – committee responsible for ambulatory health care (legally binding directives)	Coverage, Practice	Considered whether HTA recommendations were accepted by the committee	The committee decisions were consistent with HTA recommendations	Major	2

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Norezam [47], 2013 Overall output from HTA agency responses for management of diabetes mellitus and thalassaemia, CT for head injury, US in primary & antenatal care, moderately elevated blood pressure	Malaysia, Public hospitals	Coverage, Capital funding, Practice, Research	Survey of persons in public hospitals, health departments, research institutes and Ministry of Health.	% participant responses: Recommendations/ conclusions accepted : 83% Showed technology met program requirements: 79% Material incorporated into policy documents: 69% Used as reference material: 78% Linked to change in policy: 75%	Some input to decisions	3
Ju [48], 2014 35 HTAs	Australia, Queensland hospitals	Capital funding, Program, Practice, Research	Review of HTA decisions and their implementation	19 HTAs recommended funding for piloting of the technologies; this had commenced for 17 with final decision pending for 2. (e.g. greenlight laser therapy, electromagnetic navigation bronchoscopy, Xpert MTB/RIF, excimer laser system) Funding not recommended for 7 technologies (e.g. percutaneous microwave ablation, robotic navigation system)	Major	3

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Kolasa [49], 2011 151 drug therapies	Poland, National health system	Coverage, Formulary	Reimbursement lists reviewed to assess to what extent policy-makers had used the information coming from the HTAs	34 drugs appraised and reimbursed (4 negative and 30 positive HTA recommendations) 117 appraised and not reimbursed (58 positive and 59 negative recommendations)	Some input to decisions	3
Rochaix [50], 2009 Large numbers of drugs	France, National	Coverage	Review of Ministry & sickness fund decisions following HTA recommendations	> 95 % of positive HTA opinions on reimbursement status of a new technology were followed by decisions to reimburse. Almost all negative opinions were followed. 1999 – 2001: concluded 835 of 4,490 medicines showed insufficient benefit, reimbursement rates were reduced 2003 – 06: proposed delisting 370, 322 were delisted, decision to retain 48 drugs for cerebral insufficiency in the elderly population.	Major	3
Teerawattananon [51], 2014	Thailand, National – public health insurance program	Coverage	Review of decisions by Subcommittee for development of the National List of Essential Medicines on recommendations for inclusion of medicines in the list, based on economic and other assessments.	Ten medicines were accepted for inclusion in the national list, 11 were excluded and one was under price negotiation	Some input to decisions	3

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Bennie [52], 2011 Medicines that the Scottish Medicines Consortium (SMS) had not recommended for use	Scotland – National Health Service	Practice	Analysis of effect of advice from the SMS on use of medicines. Volume of prescribing measured by each medicine's gross ingredient cost to the prescribing budget	Data were available for 8 of 10 medicines not recommended for use. Use increased for 5 medicines, stabilized for 2 and decreased for 1. (Data show that use of one medicine categorized as 'stabilized' had increased)	Minimal	4
Dietrich [53], 2009 34 drugs with negative technology appraisal recommendations or positive ones with major restrictions	UK - ambulatory care of the NHS in England and Wales	Practice	Secondary analysis from the prescription costs analysis statistics and comparison with NICE recommendations	For 97 % of the drugs, the publication of NICE's 14 negative and restricting technology appraisals between 2000 and 2004, did not reduce the number of prescription items dispensed or net ingredient costs in the ambulatory care of the NHS	Minimal	4
Hailey [54], 2000 20 rapid HTAs	Canada, Alberta health system	Coverage, Capital funding, Referral, Practice	Interviews and written feedback with requestors of HTA or persons who might be influenced by the findings	Decisions by health ministry consistent with HTA advice. Two HTAs had no apparent influence.	14 Major 4 Some consideration 2 Minimal	

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Hailey [55], 2009 15 technologies	Australia, Brazil, Canada, Spain, USA – health ministries or departments	Coverage 9, Capital funding 1, Formulary 1, Referral 2, Program 2, Guideline 3, Practice 3, Research 2	Survey of INAHTA members on rapid HTAs that they had prepared during 2006.	All the HTAs were considered to have had some influence. Most common indications were consideration by the decision maker, use of the HTA as reference material (both n = 10), and acceptance of recommendations or conclusions (n = 8).	8: Major 7: Some consideration	4
Oortwijn [56], 2008 HTA research programs in detection of cancer metastases, mental & behavioural disorders, care of chronically ill, clinical genetics, infectious diseases, PET, treatment of fertility disorders	Netherlands, various primary studies supported by the Dutch HTA program	Program, Practice	Case studies using “payback framework”.	Authors comment that “it is too early to fully assess impact of the Dutch HTA program” Details might provide a baseline for future appraisal of payback Two examples of changes in practice One example of informing policy for a local insurer	Some consideration	3

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Hanney [57], 2007 9 primary studies, 4 secondary studies, 3 NICE technology assessment reviews (TARs)	UK – NHS England & Wales	Coverage, Guideline, Practice, Research	Review of first 10 years of NHS HTA Programme, included questionnaire survey of lead investigators and 16 case studies. Analysis using payback framework	Concluded programme had perceived impact on policy and to some extent on practice. 73% of survey respondents claimed projects had impacted on policy and 56% on behaviour (96% for TARs) 11 of 16 case studies thought to have made some impact on policy	Major	4
Guthrie [58], 2015 Publications from studies funded by an HTA programme	UK – NHS England & Wales	Coverage, Guideline, Practice	Review of NHS HTA Programme from 2003-2013. Interviews with 20 senior stakeholders Electronic survey of HTA grant holders. 12 payback case studies of HTA programme-funded research.	*Interviews indicated the primary route to impact of programme-funded research on patients is through influence on guidelines. * Survey responses for 93 HTA program projects reported an impact on policy, including citation in guidelines and other documents. * 7 out of 12 case studies provided some evidence research had an impact on the NHS and patients, and 4 included limited evidence of changes in clinical practice.	Major	3

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Turner [59], 2015 122 NICE clinical guidelines, issued between April 2001 and April 2012	UK – NHS England & Wales	Guideline	Retrospective cohort study, proportion of NICE guidelines which cited evidence from studies funded by the NIHR HTA Programme and the impact of those studies on the guidelines	Of 122 guidelines, 3 (2%) were based on previous NIHR HTA reports and 90 (74%) cited evidence from NIHR HTA studies. The impact of HTA evidence on the guidelines varied; the ways in which data was used by NICE was heterogeneous. There was extensive use of NIHR-HTA data in guidelines on Chest Pain of Recent Onset, The Epilepsies and Chronic Heart Failure.	Some input to decisions	3
Rosén [60], 2014 26 reports from 2006-10	Sweden - National and regional (counties)	Program, Guideline, Practice, Research	Measured the extent to which HTA reports had affected decisions, guidelines, research or clinical practice. Used documentation, before-after surveys and time series register data.	Decisions and actions of national and local government bodies, and of professional organizations. Changes in use of technologies and services. HTA reports had a high impact on clinical guidelines, and a moderate or high impact on comprehensive decisions, initiation of research and changes in clinical practice. Impact was low in three cases.	Major	4

Supplementary Table 2 (continued)						
Author, reports	Country/setting	Types of decision	Approach used	Indication of influence	Extent of influence	Quality score
Pichon-Riviere [61], 2012 HTAs from other jurisdictions	19 Latin American & Caribbean (LAC) countries, 55% responses were from Argentina	Coverage, Capital funding, Guideline, Practice, Research	Survey of decision makers and researchers on HTA transferability experiences	Decision makers reported using HTAs from other jurisdictions to guide decisions in the majority of cases: 52.6 % HTAs from outside LAC 23.1 % from other LAC countries, 24.3 %HTAs from their own countries. 63 % of researchers reported using HTAs from other jurisdictions; information regarding safety and effectiveness was considered more applicable than that on social aspects, or economic evaluation	Some consideration	3