

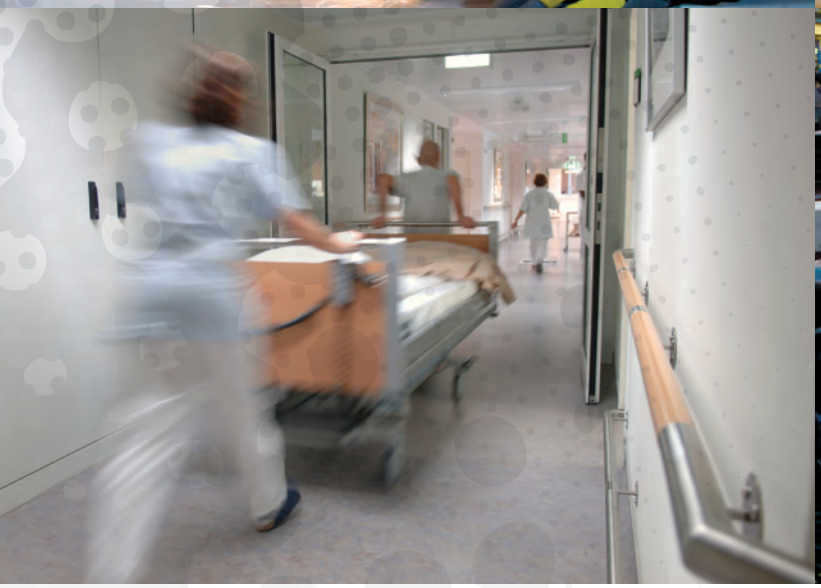


Reference Framework for Screening and Medical Surveillance in Occupational Health

SUMMARY

INSTITUT NATIONAL
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DU QUÉBEC

Québec

Reference Framework for Screening and Medical Surveillance in Occupational Health

SUMMARY

Direction des risques biologiques
et de la santé au travail

May 2011

Institut national de santé publique Québec

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1 PRESENTATION

By its very nature, screening is characterised by administering a test to presymptomatic or early symptomatic individuals who may benefit from a more effective intervention if it is performed before the usual time of diagnosis.

Far from being a trivial intervention, screening can lead to significant consequences to the people screened. Therefore, before offering screening to workers, its effectiveness and the predominance of benefits over disadvantages must be demonstrated at the population level. Furthermore, screening should have the recommended characteristics in order that the expected benefits can be observed in practice.

Approaches using algorithms or flowcharts are generally meant to be sequential. Our approach had to be flexible and allow for compromises. The proposed approach involves three key decision-making nodes, which must generally be addressed in a sequential manner. Generally speaking, a satisfactory response to one of them is required before moving on to the next. However, an evaluation of several key nodes can be performed simultaneously in an iterative way. The key decision-making nodes and underlying criteria should be viewed as a tool for analysis and reflection rather than as a rigid process.

Key decision-making nodes:

1) Have the basic conditions justifying pursuit of the evaluation been met?
2) What is the balance of the benefits of screening compared to its disadvantages, taking into account the quality of evidence?
3) To what extent does the proposed screening process have the characteristics necessary for its implementation?

Screening is performed in different contexts: it can be a "simple" screening activity, a screening program, medical surveillance, a pre-employment medical examination or a regulated medical examination. The use of screening should be evaluated from the perspective of the proposed approach and the specific aspects of each one, which are presented in the document.

Although the framework was designed to be applied specifically in the field of occupational health, the authors had a constant concern to make it as inclusive as possible and paid particular attention so that it could be applied to screening activities in the general population. However, in the case of medical examinations for non-occupational risks, the reader should consult the recommendations of experts committees or task forces and seek an understanding of the basis for their recommendations.

2 GUIDING PRINCIPLES OF RISK MANAGEMENT

The proposed approach is based on the guiding principles outlined in the *Cadre de référence en gestion des risques pour la santé dans le réseau québécois de la santé publique* (Reference framework for the management of health risk in the Québec public health network), adopted in 2003 by the Québec public health authorities (INSPQ, 2003).[2] These principles are:

Caution

Risk management in public health must advocate the reduction or elimination of risks whenever it is possible to do so, and the adoption of a vigilant attitude to act to avoid unnecessary risks. This attitude extends both in a context of relative certainty (prevention) and scientific uncertainty (precaution).

Empowerment

Risk management in public health must help strengthen the capacity of individuals and communities to make informed decisions and act on the risks that concern them.

Fairness

Risk management in public health must ensure the fair distribution of the benefits and disadvantages associated with risks within communities.

Openness

Risk management in public health must allow interested and affected parties to participate in the process so they can express their views, share their perceptions and concerns about the situation, contribute to finding solutions and influence management decisions.

Primacy of the protection of human health

Risk management in public health must give priority to the protection of human health.

Scientific rigour

Risk management in public health must be based on the best available knowledge, and on scientific advice from experts from all relevant disciplines; it must consider minority views and opinions from various schools of thoughts; and it must follow a structured and systematic approach.

Transparency

Risk management in public health must provide easy access to all critical information and explanations that are relevant to interested and affected parties as fast as possible, while respecting the legal requirements of confidentiality.

[2] http://www.inspq.qc.ca/publications/notice.asp?E=p&NumPublication=163 (available only in French).

3 DEFINITIONS

The framework provides definitions for several terms with the goal of establishing a common vocabulary among stakeholders from different disciplines of occupational health as well as workers and employers or their representatives.

Test

Any questionnaire, clinical examination or complementary investigation (laboratory, radiology, etc.) that is administered to an individual. When used in a screening context, it generally does not provide a definitive result. Proper follow-up is required specific to each test result.

Screening

The application of tests to an individual who is part of a group sharing common characteristics. The goal of screening is to differentiate individuals who likely have an undiagnosed illness or who have a risk factor for a given disease from those who are unlikely to have the disease.

Table 1 Main differences between tests applied in screening versus diagnostic contexts

Screening test	Diagnostic test
When a test result is abnormal, this step is a precursor to a diagnostic approach.	It is used as a second step after a screening test or in symptomatic patients. It helps confirm the presence or absence of illness.
It is applied to persons not apparently affected by the illness sought.	It is applied to persons with symptoms suggestive of the disease.
It is not meant to support the therapeutic decision.	It most often leads to the determination of treatment options or directs the focus to another diagnosis.

Surveillance

Close watch kept over someone or something. In the context of public health, surveillance is a recurring activity through which one conducts monitoring and it should lead to corrective action if necessary.

Populational (epidemiological) surveillance

The ongoing process of assessing the health of a population and its determinants through the collection, analysis and interpretation of relevant data, as well as their systematic and regular dissemination to those who need to be aware of this data in order to reduce morbidity and mortality and to improve health.

Medical surveillance (in the workplace)

Screening activity that is repeatedly applied to the same person, and that should lead to preventive follow-up interventions (Figure 1).

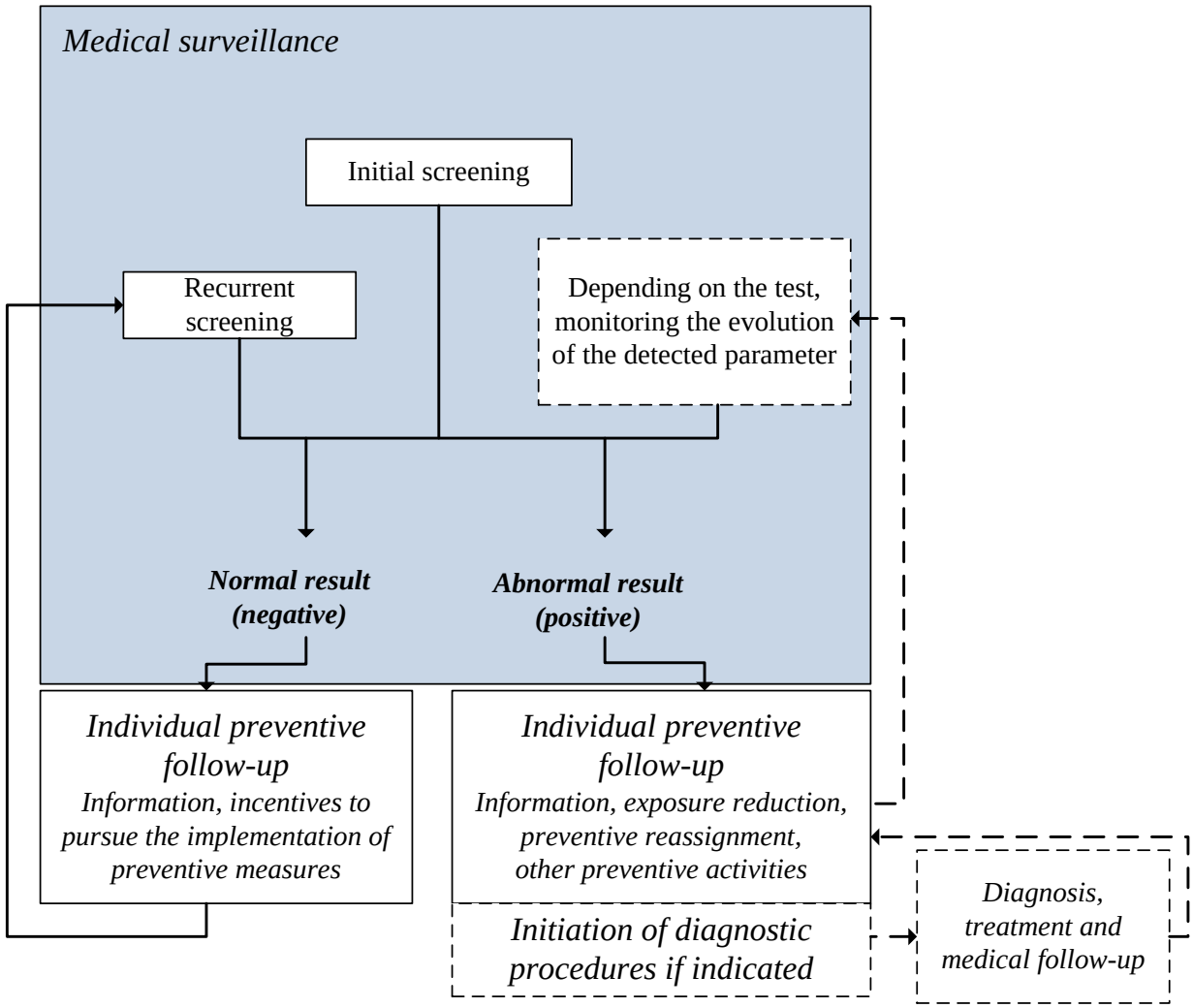

Figure 1 Concept of medical surveillance and other preventive activities

Note: Strictly speaking, medical surveillance (in the workplace) is represented by the shaded portion of the figure. The other items are included to make it easier to understand. Dotted arrows and boxes indicate that these activities are only implemented as appropriate. It is also worth noting that, for the sake of simplicity, not all options are shown. Finally, the possibility of an equivocal result and the conducting of appropriate follow-up under these circumstances, which usually involves re-testing, are not shown in the figure.

4 CONCEPTUAL MODEL

The conceptual model below serves to illustrate the natural history of illness and its relationship with the concepts of screening and medical surveillance (Figure 2).

The natural history of an illness after exposure to the risk factor of interest is divided into several successive stages until the ultimate consequence of this exposure: deficiency, impairment, disability or death. However, a favorable evolution of the illness, i.e., towards reversibility (detoxification, repair, healing) is possible and is shown at the top of the illustration.

Susceptibility factors can be divided into acquired factors (environmental, biological or associated with lifestyle) and inherited factors (genetic predisposition). Moreover, susceptibility factors include protective factors, which have a positive impact and lead to the slowing down, stopping or reversal of the illness process.

The concepts of environmental surveillance, medical surveillance, screening and medical follow-up appear under the continuum of the natural history of illness.

The steps are illustrated based on a chronological sequence of a cause-and-effect model. However, the progression of an illness is not necessarily linear. A multidimensional representation, covering several possible routes, could be more representative of the phenomena that take place in reality. This linear paradigm is generally adopted given its simple and practical presentation.

This model is generic, applicable to many risk factors that influence occupational health and covering a wide variety of characteristics related to both the environment and the organization of work. Designed primarily for application in occupational health, it can also be applied to other areas. Depending on the risk factor considered, some stages of the natural history can be omitted, precluding the obligatory passage through each step of the continuum.

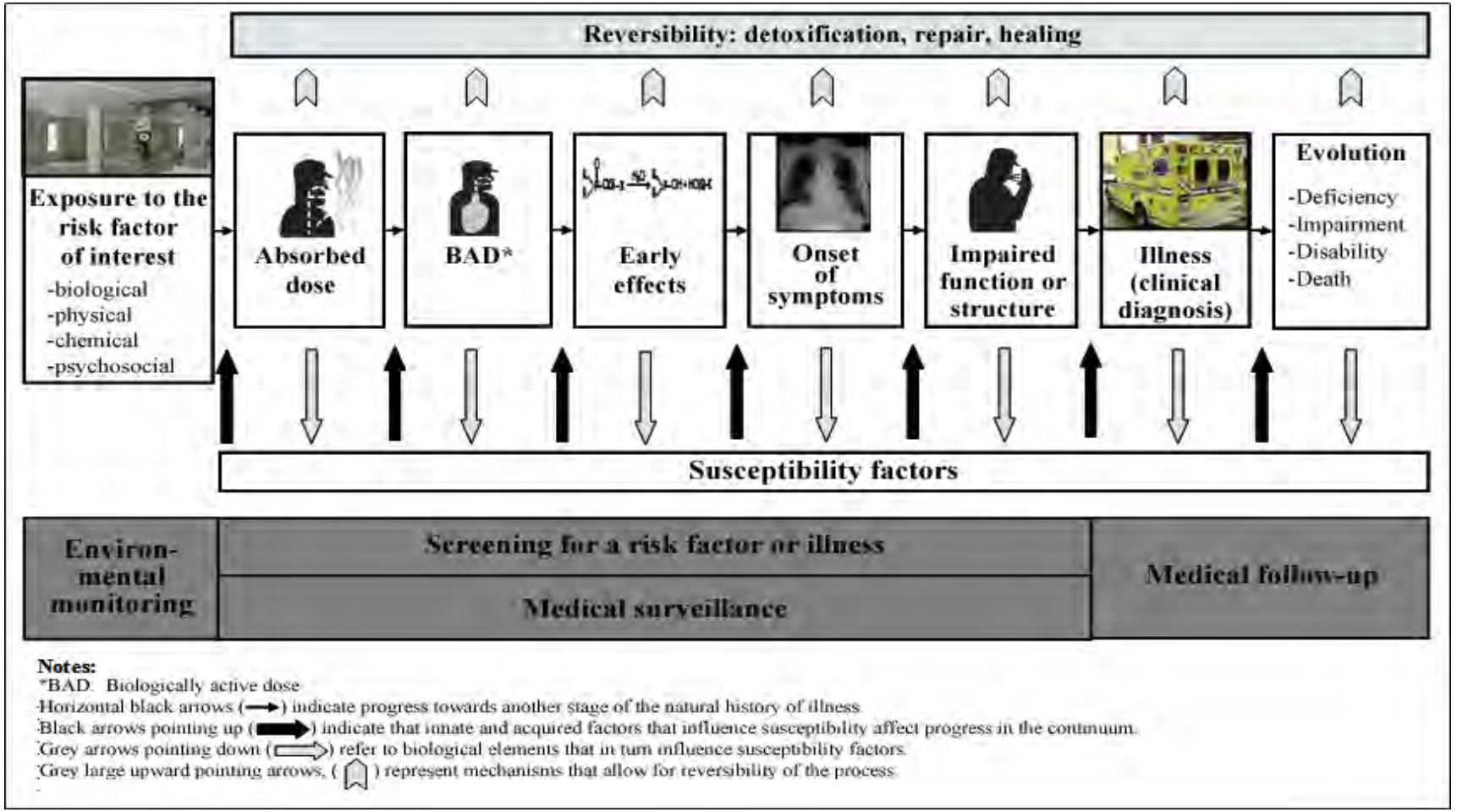

Figure 2 Conceptual model: Natural history of illness and its relationship with screening and surveillance in the workplace

The examples shown relate to only a few risk factors among the multitude of factors that may be present in the workplace. They also demonstrate only a few possible scenarios of disease progression, some phenomena for each stage of the continuum and some susceptibility factors.

Table 2 Examples of application of the conceptual model to different risk factors in the workplace

Exposure to the risk factor of interest	Absorbed dose	Biologically active dose	Early biological effects	Impaired function or structure	Onset of symptoms	Illness (clinical diagnosis)	Evolution/ Reversibility	Susceptibility factors
Biological								
Meningo-coccus[a]	ND[b]	ND	Stimulation of the immune system	ND	Fever	Meningo-coccal meningitis	Healing following antibiotic treatment, but with sequelae (deafness)	Vaccination against A, C, Y, W strains (partial protection factor)
Water containing hepatitis A viruses[c]	ND	ND	Stimulation of humoral immunity	Destruction of hepatocytes and release of enzymes	Jaundice, fatigue and fever	Hepatitis A serologically confirmed (IgM)	Back to full functionality	Age, pre-existing hepatitis, alcoholism
Chemical								
Lead[d]	Blood lead level (BLL)	BLL	Effect on the metabolism of heme	Decreased synthesis of hemoglobin	Fatigue, shortness of breath on exertion	Frank anemia	Healing following withdrawal from exposure	Diet low in iron
Lead	BLL	ND	ND	Altered neuro-psychiatric function	Affected judgment, mood, learning ability	None	Recovery	Poor adjustment of the respirator
Ethylene Oxide[e]	Hemoglobin adducts	DNA adducts	None	None	None	None	DNA repair	Exposure to other genotoxic chemical

[a] Information provided by Pierre Deshaies, a member of the Expert Committee, pers. comm. (2006).

[b] ND means "not determined," either because the process is unknown, or because the information is not available.

[c] Information provided by Denis Laliberté, member of the Expert Committee, pers. comm. (2007).

[d] For the two examples related to lead, the information was obtained from Plante et al., 2003 and completed by Luc Bhérer, member of the Expert Committee, pers. comm. (2006).

[e] Based on information from the ILO (Sauter et al., 2000).

Table 2 Examples of application of the conceptual model to different risk factors in the workplace (cont'd)

Exposure to the risk factor of interest	Absorbed dose	Biologically active dose	Early biological effects	Impaired function or structure	Onset of symptoms	Illness (clinical diagnosis)	Evolution/ Reversibility	Susceptibility factors
Physical								
Vibrations[f]	Energy absorbed	Vibration dose received by hand-arm system	Increased sympathetic tone of the central and peripheral nervous system	Predominance of alpha-2 receptors because of affected alpha-1 receptors in the intima, vasoconstriction	Edema of the hands at the end of the day	Vaso-spastic effect	Healing	Exposure to cold, stress
Ionizing radiation[g]	Inhaled radionuclides	Mutation of the HPRT gene[h]	Chromosomal damage	Hyperplasia	Cough with expectoration of blood	Lung cancer	Death	Smoking
Noise[i]	Energy of sound reaching the cochlea	Dose of noise reaching the hair cells in the cochlea	Morphological and biochemical changes in hair cells in the cochlea, circulatory changes	Destruction of hair cells in the cochlea and degeneration of auditory nerve fibers, decreased sensitivity, selectivity, auditory discrimination and localization[j]	Frequent requests for verbal information to be repeated, increasing the volume of television, particularly in the presence of background noise, withdrawal from social activities	Irreversible sensorineural hearing loss	Disabilities caused by listening and communication difficulties	Exposure to an ototoxic contaminant (e.g. CO, drugs), exposure to vibrations, adjustment of the workstation with reduced communication problems (protection factor)

[f] From Boileau and Turcot (2004) and Turcot (2005) reports, completed by Alice Turcot, medical consultant, Direction de santé publique de Chaudière-Appalaches and Institut national de santé publique du Québec, pers. comm. (2006). The vibration dose received by the hand-arm system takes into account the duration of the exposure and the level of overall vibration received in the hands and arms (Boileau and Turcot, 2004).

[g] From Schulte (1989), Veulemans et al. (2007) and the "Lung Cancer" Web site of the Québec Lung Association, accessed March 26, 2006: http://www.pq.lung.ca/diseases-maladies/cancer-cancer/.

[h] HPRT gene: Hypoxanthine-guanine phosphoribosyl transferase.

[i] Information provided by Pierre Deshaies, a member of the Expert Committee, personal communication (2006) and by Pauline Fortier M. O.A., audiologist, Direction de santé publique de la Montérégie and Institut national de santé publique du Québec, personal communication (2008), and supplemented by information from the WHO (1999).

[j] There may also be a reduced ability to withstand loud sounds (hyperacusis) and the presence of tinnitus.

Table 2 Examples of application of the conceptual model to different risk factors in the workplace (cont'd)

Exposure to the risk factor of interest	Absorbed dose	Biologically active dose	Early biological effects	Impaired function or structure	Onset of symptoms	Illness (clinical diagnosis)	Evolution/ Reversibility	Susceptibility factors
Work pace too high[k]	ND	ND	Inflammation	Increased muscle fatigue	Diffuse and dull pain in the shoulder, felt especially during movements	Tendinitis of the rotator cuff (shoulder)	Rehabilitation	Awkward working position, age
Psychosocial								
Highly automated production processes[l]	ND	ND	Increased secretion of stress hormones	Structural modifications of blood vessels	Hypertension	Cerebro-vascular accident (CVA)	Disabilities	Working under time constraints, lack of significance of the task, low decision latitude
Repetitive and monotonous work[m]	ND	ND	Increased secretion of stress hormones	Psychic tension	None	None	Recovery	Individual propensity to respond positively to stress determined by experience and achievements in early childhood (protection factor)
Repeated situations of harassment or demeaning acts[n]	ND	ND	Increased secretion of stress hormones	Psychic tension	Insomnia, loss of appetite, fatigue, difficulty concentrating	Depressive illness	Suicide	Concurrent stressors (e.g. divorce, death of a loved one) and low employee recognition

[k] Information provided by Alice Turcot, medical advisor, Direction de santé publique de Chaudière-Appalaches and Institut national de santé publique du Québec, pers. comm. (2006), supplemented by information from the Passeport santé Web site: Troubles musculosquelettiques de l'épaule, accessed March 27, 2006: http://www.passeportsante.net/fr/Maux/Problemes/Fiche.aspx?doc=troubles_musculosquelettiques_epaule_pm.

[l] Based on information from the ILO (Sauter et al., 2000).

[m] From Vézina (1992).

[n] Based on information from the ILO (Sauter et al., 2000) and from the DSM-IV-TR (American Psychiatric Association, 2003).

5 CRITERIA FOR SCREENING AND MEDICAL SURVEILLANCE

Three decision-making nodes are involved in this approach (Figure 3). The first decision-making node examines basic conditions to determine if further evaluation is warranted to justify screening.

The second node focuses on assessing the magnitude of the benefits and disadvantages, and the quality of the evidence. These two parameters, evaluated for a population (group) of workers, together ascertain the rating attributed to the strength of the recommendation made. Each recommendation level dictates the relevance or not of offering screening, the underlying conditions, and the communication approach for each situation.

The third node assesses the extent to which the implementation of a screening activity meets a number of criteria to ensure appropriate and effective implementation.

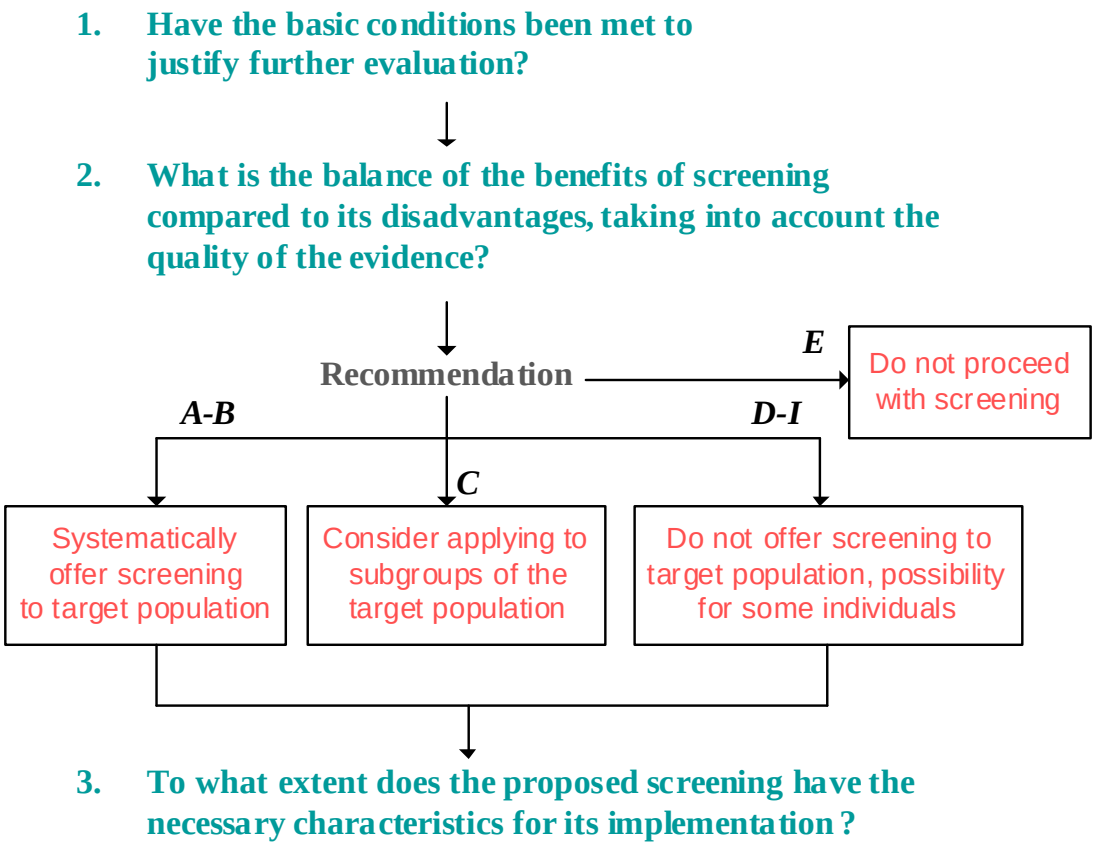

Figure 3 Decision tree

Each decision-making node comprises several criteria that must be analyzed. Although the three decision-making nodes must always be addressed, the criteria themselves form somewhat of a checklist to identify the elements that must be considered before administering a screening test, irrespective of which one it is. It must also be noted that the numbering of the criteria is not an indication of the order in which they must be examined.

The process may be altered according to the circumstances surrounding the screening. What is critical is that the process be transparent and that the reasons for administering a test despite non-compliance or the non-consideration of certain criteria be explicit, should such a situation arise.

5.1 FIRST DECISION-MAKING NODE AND UNDERLYING CRITERIA

The reasons that were the basis for considering screening serve as the starting point for an analysis of the legitimacy of screening. A brief summary of the information should help determine the burden of illness associated with the health problem that is to be prevented, the existence of a window of opportunity for early intervention, and the possibility of using a test related to the target condition.

Node 1. Have the basic conditions to justify further evaluation been met?

Criteria:

1-1 The condition that is to be prevented is serious or common.

1-2 The duration of the pre-symptomatic or early symptomatic phase lends itself to an intervention before the illness would normally be diagnosed.

1-3 A test related to the risk factor or the targeted occupational illness exists.

5.2 SECOND DECISION-MAKING NODE AND UNDERLYING CRITERIA

Once the first decision-making node has been addressed, it is ethically imperative to ensure that screening will provide more benefit than harm for the target population. This is particularly true when the screening is to be proposed by health professionals rather than by the individuals screened, or when it has been required by a third party.

The objective of the second decision-making node is to compare the magnitude of the anticipated benefits and disadvantages for the target population. This evaluation must be based on evidence whose quality must be assessed.

Node 2. What is the balance of the benefits of screening compared to its disadvantages, taking into account the quality of the evidence?

Criteria:

2-1 Interventions performed following the screening have a greater capacity to reduce mortality and morbidity from a population-based perspective compared to interventions performed when the illness is normally diagnosed.

2-2 Sensitivity and specificity values are taken into account in determining the effectiveness of screening.

2-3 The disadvantages associated with testing and the subsequent interventions from both physical and psychological perspectives, evaluated at the population level, are deemed acceptable when compared to the expected benefits.

5.3 RECOMMENDATIONS

The balance of benefits over disadvantages at the population level, for a target population of workers, is classified according to a semi-quantitative, five-level scale:

- Very positive
- Moderately positive
- Slightly positive
- Nil (benefits comparable to disadvantages)
- Negative (disadvantages outweigh benefits)

For its part, the assessment of the quality of the evidence associated with net benefits is classified according to three levels:

- Evidence of good quality
- Evidence of sufficient quality
- Insufficient evidence (quantity or quality)

Combining the estimate of the magnitude of the net benefits generated and the assessment of the quality of the evidence associated with them, both for the population of targeted workers, determines the allocation of an A, B, C, D, E or I rating (Table 3).

Table 3 Recommendation rating matrix

Population-based quality of the evidence[a]	**Balance of benefits over disadvantages at the population level**[a]				
	Very positive	**Moderately positive**	**Slightly positive**	**Nil**	**Negative**
Evidence of good quality	A	B	C	D	E
Evidence of sufficient quality	B	B	C	D	E
Insufficient evidence (quantity or quality)	I				

[a] For the target population of workers.

Screening recommendations vary according to the rating of the evidence, as shown in Table 4. Unlike traditional presentations of recommendation ratings, this table includes communication approaches, which form part of the recommendation as important elements in conducting the screening. It should be noted that the recommendations are specific to a given screening test and to a given target population. They may therefore differ with changes in these variables.

Table 4 Types of recommendations and communication approaches classified by strength of the recommendation

Strength of the recommendation		Recommendations for health professionals	
Rating	**Description of rating**	**Type of recommendation**	**Communication approach**
A	Evidence of screening effectiveness of good quality and benefits substantially exceed disadvantages at the population level.[a]	Systematically offer screening to the target population.	Inform individuals from the target population of the anticipated screening benefits and disadvantages and of the opportunity for each individual to have it, taking into account the risk factors and personal expectations.
B	Quality of the evidence of screening effectiveness at least sufficient and benefits moderately surpass disadvantages at the population level.[a]	Same as A.	Same as A.
C	Quality of the evidence of screening effectiveness at least sufficient and benefits slightly surpass disadvantages at the population level.[a]	Consider screening only for subgroups with greater likelihood of benefits compared to disadvantages.	Only inform individuals from the subgroups for which screening has a greater probability of benefits compared to disadvantages. The information provided should cover the anticipated benefits and disadvantages of screening and the possibility for each individual to have it, taking into account the risk factors and personal expectations.
D	Quality of the evidence of screening effectiveness at least sufficient and benefits comparable to disadvantages at the population level.[a]	Do not offer screening to the target population.	No information is provided, unless requested by an individual or a group. In such a case, the information must pertain to the reasons warranting not offering the screening, including the anticipated benefits and disadvantages of screening. If, despite these explanations, a person still wants to take the test given its risk factors and his/her personal expectations, personalized information is preferred to ensure an informed decision.
E	Quality of the evidence of screening ineffectiveness at least sufficient and disadvantages surpass benefits at the population level.[a]	Do not proceed with screening.	No information is provided, unless requested by an individual or a group. In such a case, information must be provided justifying the recommendation not to screen, including the fact that the disadvantages outweigh the benefits of screening.
I	Insufficient evidence (quantity or quality)[b] so that the balance of benefits and disadvantages cannot be determined.[a]	Do not offer screening to the target population.	Same as D. The course of action may however differ depending on the importance of the alleged benefits and disadvantages and whether tests are experimental or are commonly used in clinical practice or public health. Further research should also be encouraged, when conditions are suitable.

[a] For the target population of workers.

[b] Insufficient number of studies OR sufficient number of studies for which results are inconsistent with respect to the direction and strength of the association (GRGT 2007).

5.3.1 Types of recommendations

The formulation of a recommendation is only valid for the targeted population of workers. The probability that the benefits anticipated at the population level apply at the individual level varies according to the quality of the evidence and the magnitude of the net benefits that, in all likelihood, would be generated for the target population. The approach, however, takes into account that risk factors and personal expectations have an impact on the probability that a specific individual will benefit from screening.

In occupational health, routinely offering screening (ratings A and B) to the target population means taking proactive steps in all the workplaces concerned, where exposure to the risk factor is known or suspected.

When the benefits of screening only slightly outweigh the disadvantages (C rating), it should only be offered on a limited basis. Screening should not be systematically recommended, but it could be justifiable to offer it to sub-groups for whom screening is perceived to have a greater probability of benefits over disadvantages.

Not offering screening (ratings D and I) means avoiding taking the lead in regards to disclosure of information about the existence of a screening test and to only respond to requests that might come from an individual or a group of individuals. The recommendation not to screen (E rating) means to refrain from administering the test, regardless of whether it is requested or not.

5.3.2 Approaches to communication

Communication approaches have an important role in the implementation of screening. They take the form of a proactive group approach to communicate with the target population of workers in all cases where screening is offered to a population or sub-groups (ratings A, B or C) as well as the communication of results and, if needed, follow-up counselling to individual workers. The screening process should be described as well as the interpretation of results and expected follow up. In situations where the recommendation is rated D, E or I, a group approach is used only in response to a request from an individual or from a group of workers.

5.4 THIRD DECISION-MAKING NODE AND UNDERLYING SCREENING CRITERIA

Once it has been established that screening can be offered and how, either to a target population or to individual workers, this does not mean that one can automatically proceed. There are other criteria (#3-1 to 3-15) that constitute conditions for success so that every screening activity is conducted in an appropriate and optimal manner, and the efficiency demonstrated during the evaluation of the evidence (second decision-making node) is translated into practice when the screening is administered. Note that criteria #3-12 to 3-15 inclusive become mandatory when establishing a screening program or when screening is made compulsory by law.

Node 3. To what extent does the proposed screening have the necessary characteristics for its implementation?

Criteria:

3-1 Screening should[3] be done as a supplementary activity along with essential primary prevention measures (i.e., exposure reduction, improvement of working methods, etc.) and should not be conducted at the expense of the latter.

3-2 In the case of screening for illness, abnormal results should be confirmed by diagnostic tests before any treatment is administered, unless the screening test is itself a diagnostic test.

3-3 The medical and professional follow-up of individuals with abnormal test results, including accidental discoveries of abnormal results, should be defined prior to undertaking the screening process.

3-4 In the case of equivocal results following a screening test, the appropriate subsequent follow-up should be defined prior to undertaking the screening process.

3-5 Efforts should be made to ensure that individuals in the target population can be identified and reached.

3-6 Screening tests, diagnostic tests and treatments, as well as the selection of the target population should be ethically, legally and socially acceptable.

3-7 The goals and objectives of a proposed screening process or program and the responsibilities of each player should be explicitly defined prior to undertaking the screening process.

3-8 There should be trained personnel and the necessary resources for the recruitment of participants, and carrying out screening tests, diagnosis, treatment and appropriate follow-up for each step, as well as for the management and continuity of screening activities.

3-9 The frequency of testing should be determined based on the natural history of the illness.

3-10 Information on the screening benefits and disadvantages from a population and an individual perspective for the person screened person should be communicated to that person. The decision to participate in screening and to be informed of the results or not must be made in a free and informed manner.

3-11 No personal data emanating from screening should be provided to third parties, including the employer, unless the individual concerned has given his/her explicit consent or it is prescribed by legislation.

[3] In this document, the use of "should" indicates a recommendation or that which is advised and preferable, but without making it an absolute requirement.

Criteria #3-12 to 3-15 must be respected when implementing a program or prescribing screening through by-law. These criteria are nevertheless recommended for all screening activities.

3-12 The governance structure that will be accountable for the allocation of resources and the impact of screening should be identified.

3-13 Appropriate mechanisms for quality assurance should be established.

3-14 Screening should be subject to periodic evaluation (structure, process, outcomes, and impact).

3-15 Updating scientific information about the relevant aspects of screening should be undertaken to take into account the evolution of knowledge.

For those who would like more information on the topic, the full report entitled “Cadre de référence pour le dépistage et la surveillance médicale en santé au travail” is available in French with the full references list on the following Web site: http://www.inspq.qc.ca/publications/notice.asp?E=p&NumPublication=990.

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INTERNATIONALE

LABORATOIRES
ET DÉPISTAGE

Institut national
de santé publique
Québec