ESCOLA SUPERIOR
DE SAÚDE DO ALCOITÃO

SANTA CASA da Misericórdia de Lisboa

Hogeschool
van Arnhem en Nijmegen
HAN University

Oxygen transport: a physiologically-based conceptual framework for the practice of cardiopulmonary physiotherapy

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2008

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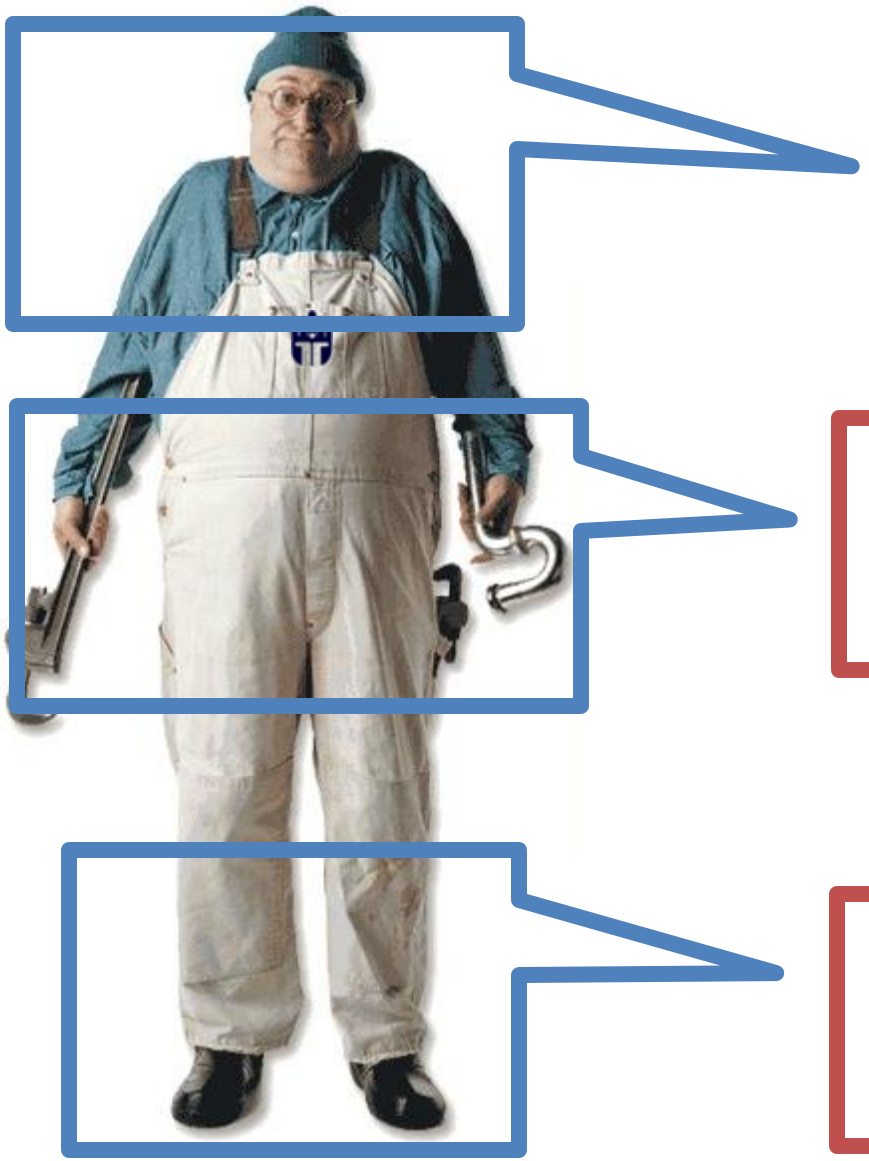
ICU Setting

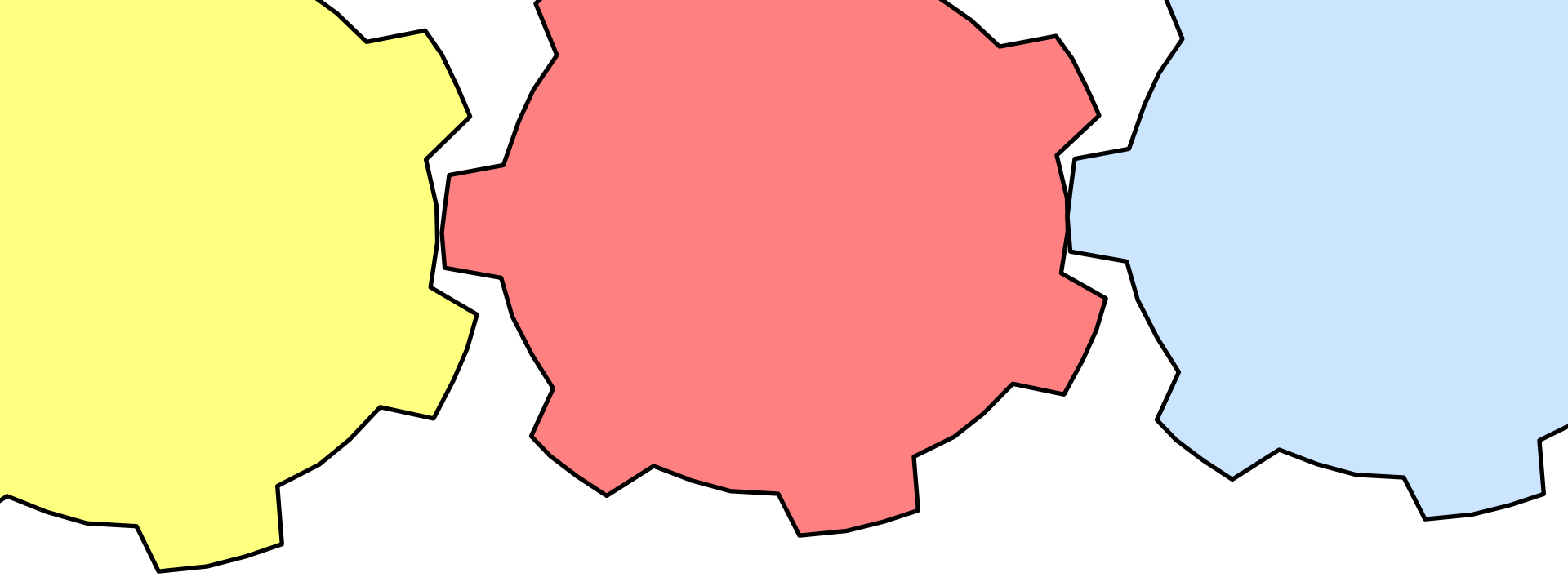
Desterro Hospital



Lift up patients

Secretion clearance

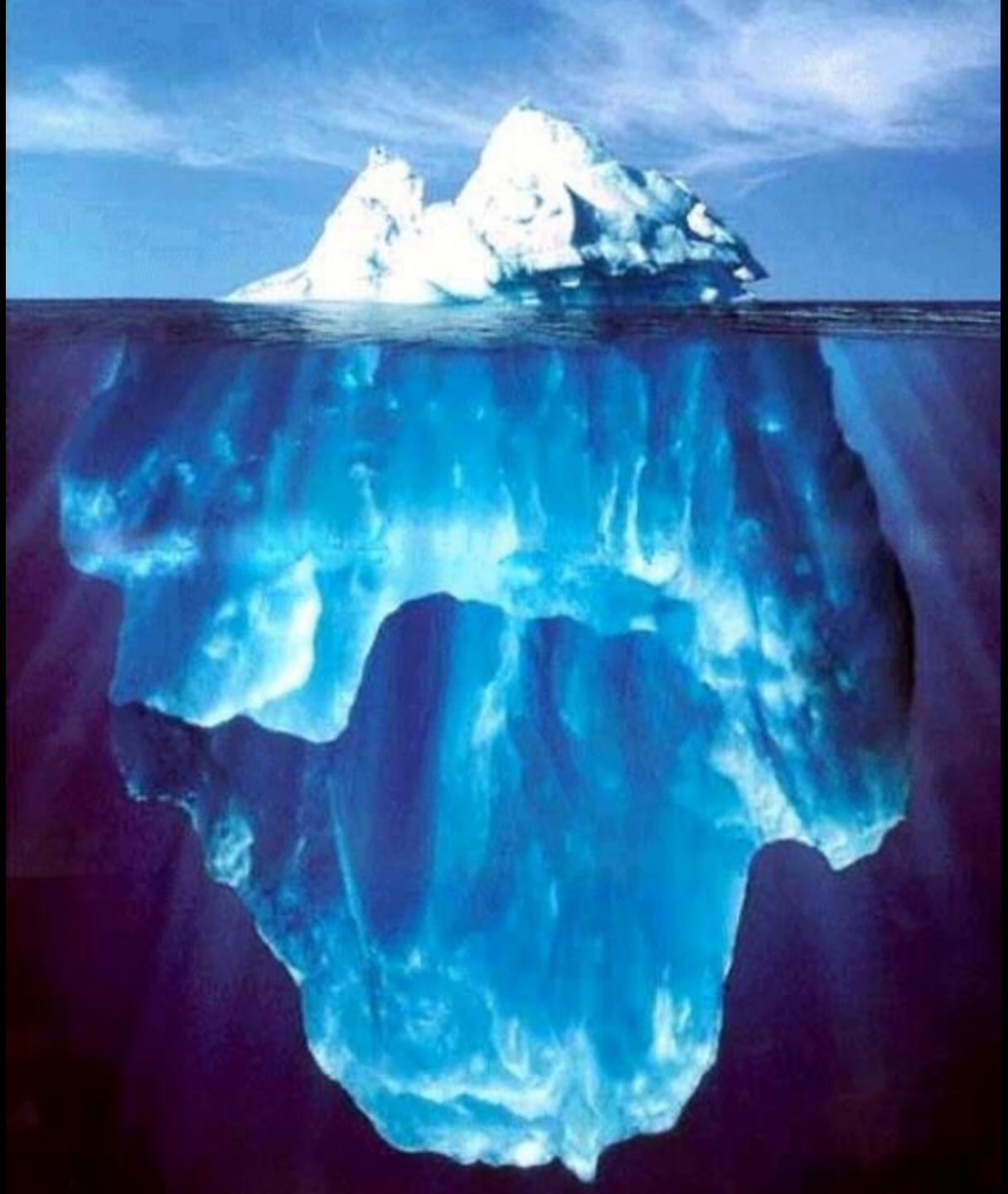
mess up patients beds



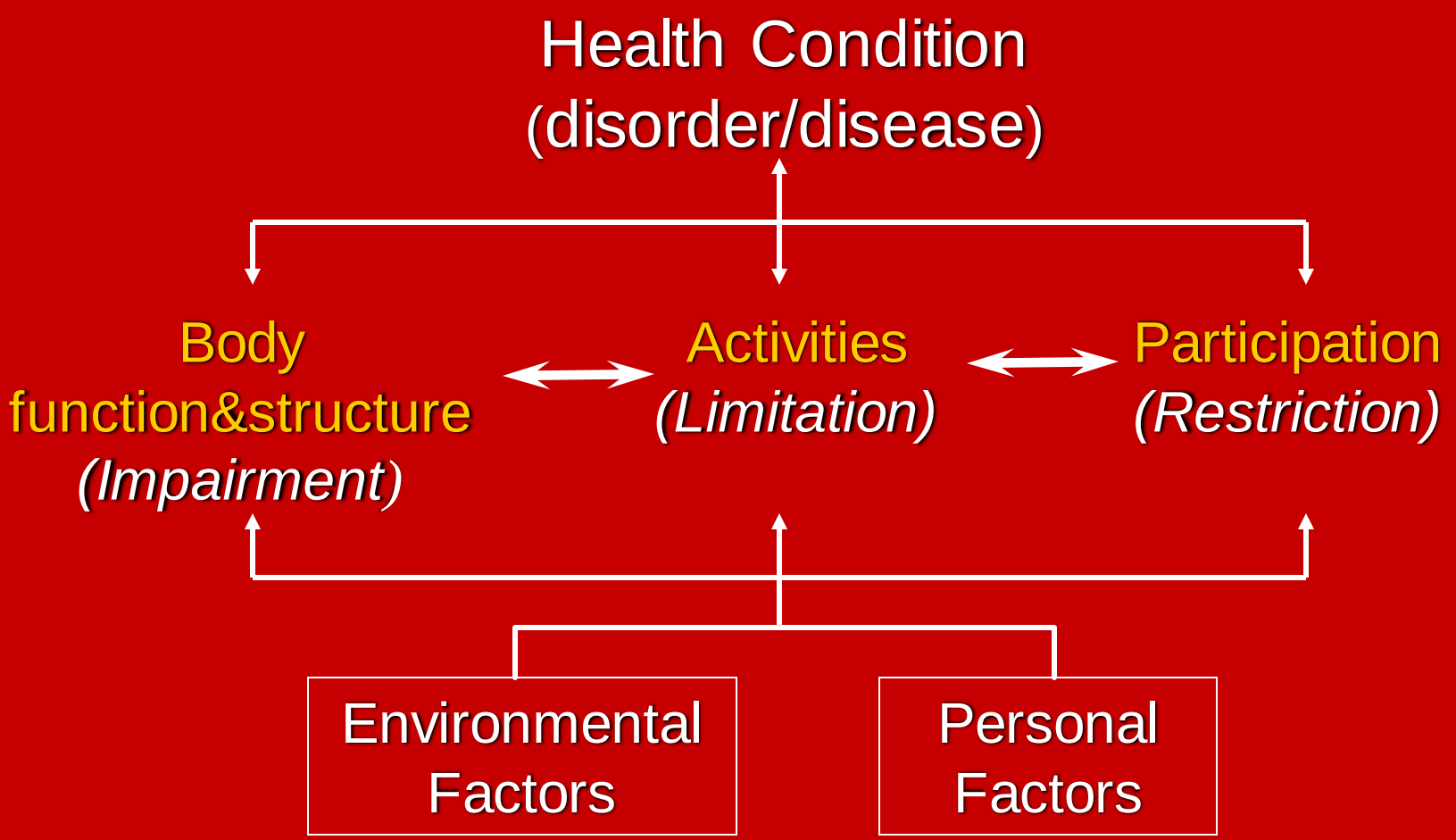
INTERVENTION FRAMEWORKS

"Your biggest problem is I don't know what your biggest problem is."

House M.D



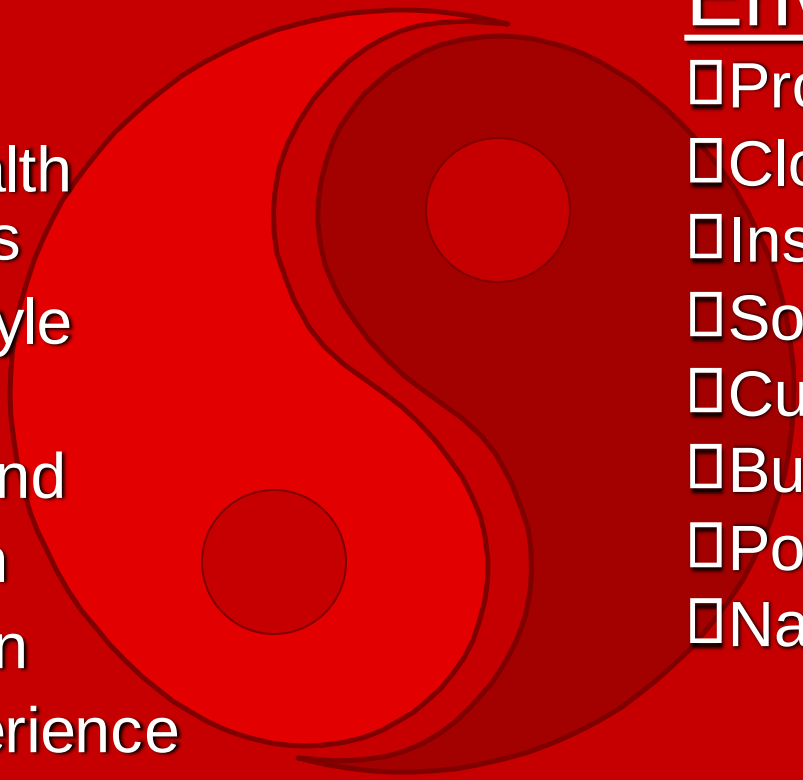
Interaction of Concepts ICF 2001



Contextual Factors

Person

- gender
- age
- other health conditions
- coping style
- social background
- education
- profession
- past experience
- character style



Environment

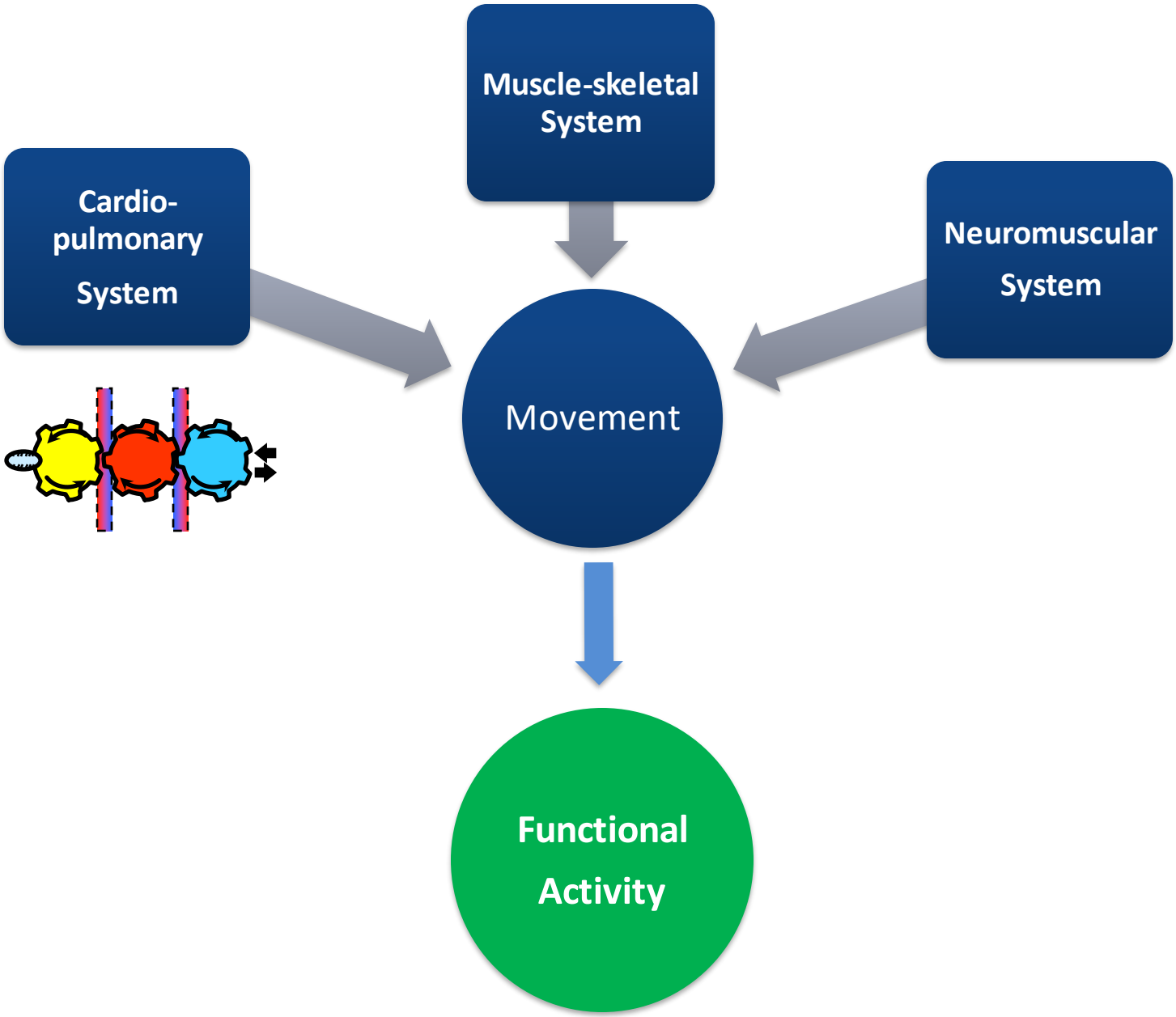
- Products
- Close milieu
- Institutions
- Social Norms
- Culture
- Built-environment
- Political factors
- Nature

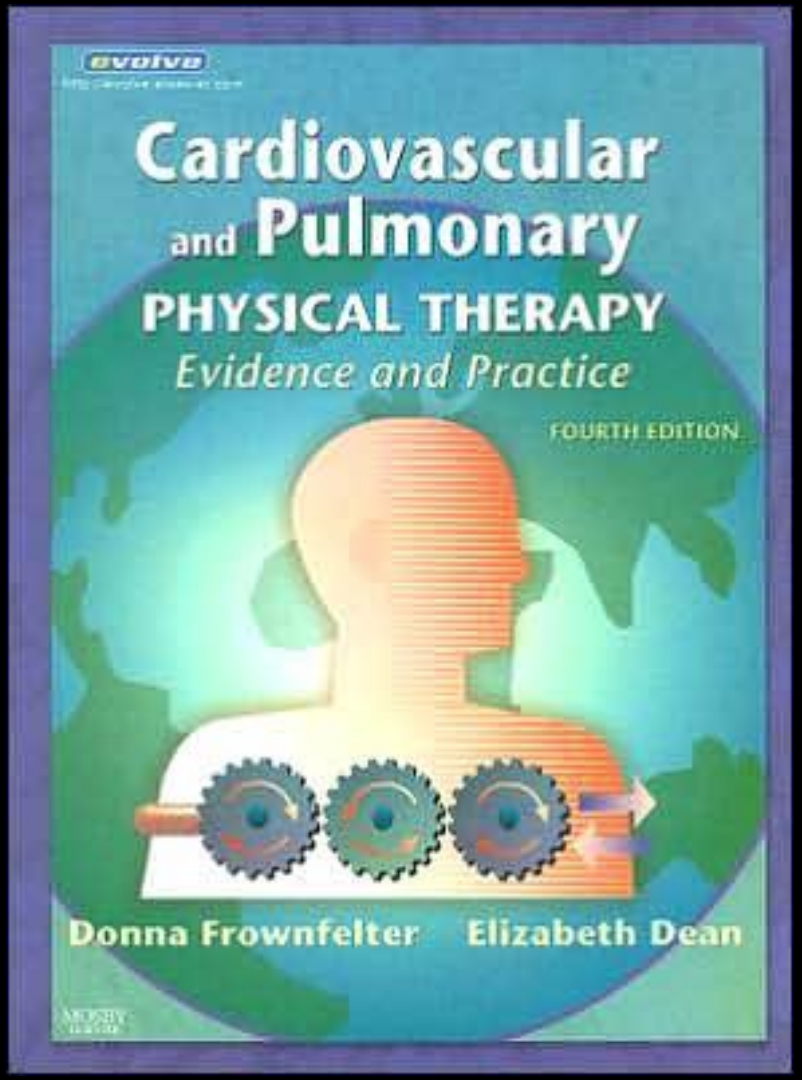
ICF Components

Body Functions & Structures	Activities & Participation	Environmental Factors
 	 	
Functions	*Capacity*	*Barriers*
Structures	*Performance*	*Facilitators*

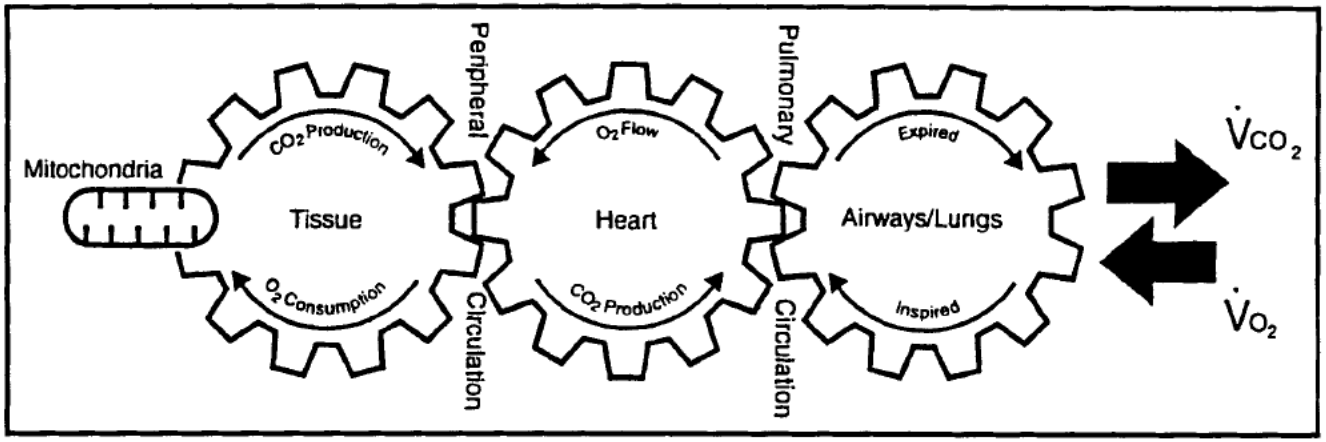
Body Functions and Structures

Mental functions	Structures of the nervous system
Sensory functions and pain	The eye, ear and related structures
Voice and speech functions	Structures involved in voice and speech
Functions of the cardiovascular, haematological, immunological and respiratory systems	Structures of the cardiovascular, immunological and respiratory systems
Functions of the digestive, metabolic and endocrine systems	Structures related to the digestive, metabolic and endocrine systems
Genitourinary and reproductive functions	Structures related to the genitourinary and reproductive systems
Neuromusculoskeletal and movement-related functions	Structures related to movement
Functions of the skin and related structures	Skin and related structures


Muscle-skeletal System
Cardio-pulmonary System
Neuromuscular System
Movement
Functional Activity


evolve
Cardiovascular and Pulmonary PHYSICAL THERAPY
Evidence and Practice
FOURTH EDITION
Donna Frownfelter
Elizabeth Dean
MOSBY

oxygen transport system

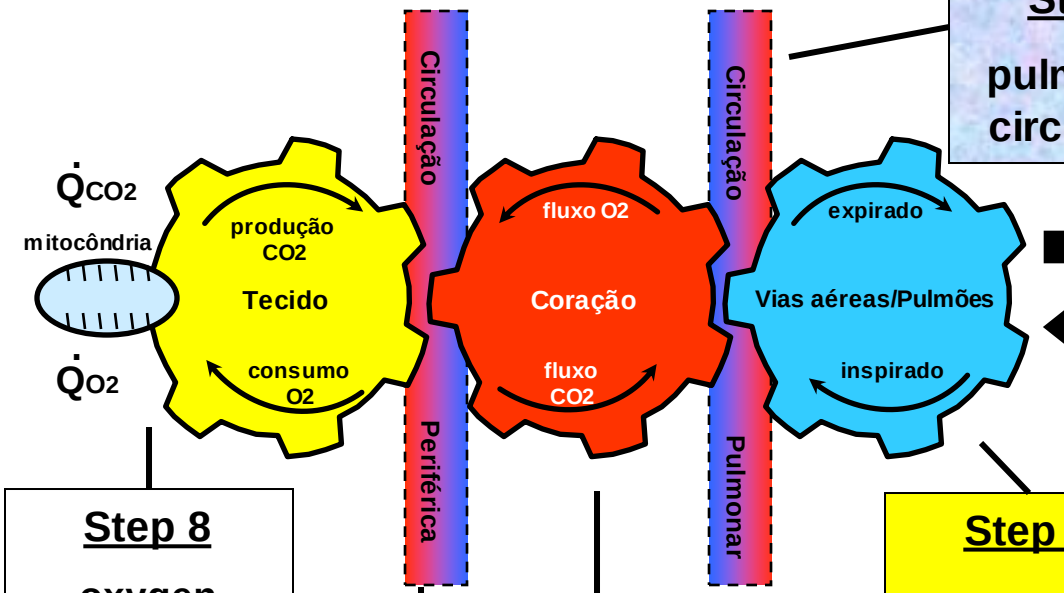


delivery or supply of **fully oxygenated blood** to peripheral tissues, the cellular uptake of oxygen, the utilization of oxygen in the tissue, and the return of partially desaturated blood to the lungs.

The steps in this system include:

Step 9

Return of CO2 and partially desaturated blood to the lungs



Step 5

pulmonary circulation

Atmosfera

N2,O2,CO2
760 mm Hg
humidade
qualidade ar

Step 8

oxygen extraction and utilization in the muscle and tissues

Step 6

Cardiac Function

Step 2

Airways

Step 3

Lungs

Step 1

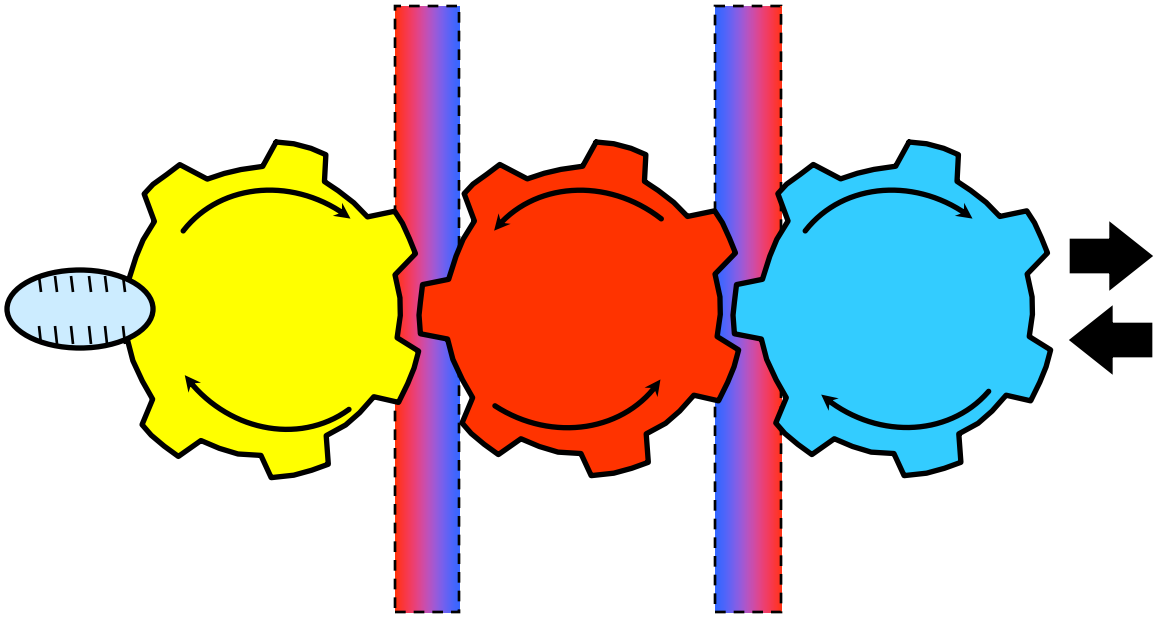
the quality of inspired gas

Step 7

Peripheral circulation

Step 4

diffusion



- **No one step is rate limiting; rather each step can individually alter oxygen transport to organ tissues.**
- The system attempts to compensate for impairment at any step.
- In health, this system is acutely responsive to changes in oxygen demand, and changes oxygen delivery correspondingly.

Physical Therapy Process

Physiotherapy Process

- **Focusing on the STO2 problems**
- **Focusing on the assessment of the STO2**

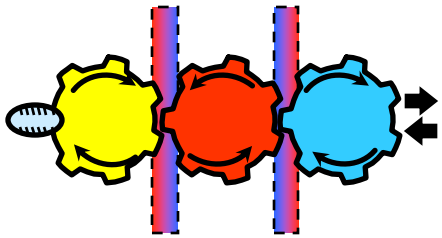
- Enable the physical therapist to identify oxygen transport impairments that compromise functional capacity and contribute to life threatening risk.

Dean & Frownfelter (2006)

Interaction of Concepts

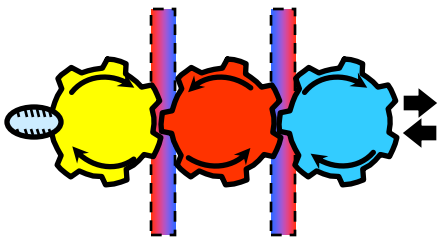
Health Condition
(disorder/disease)

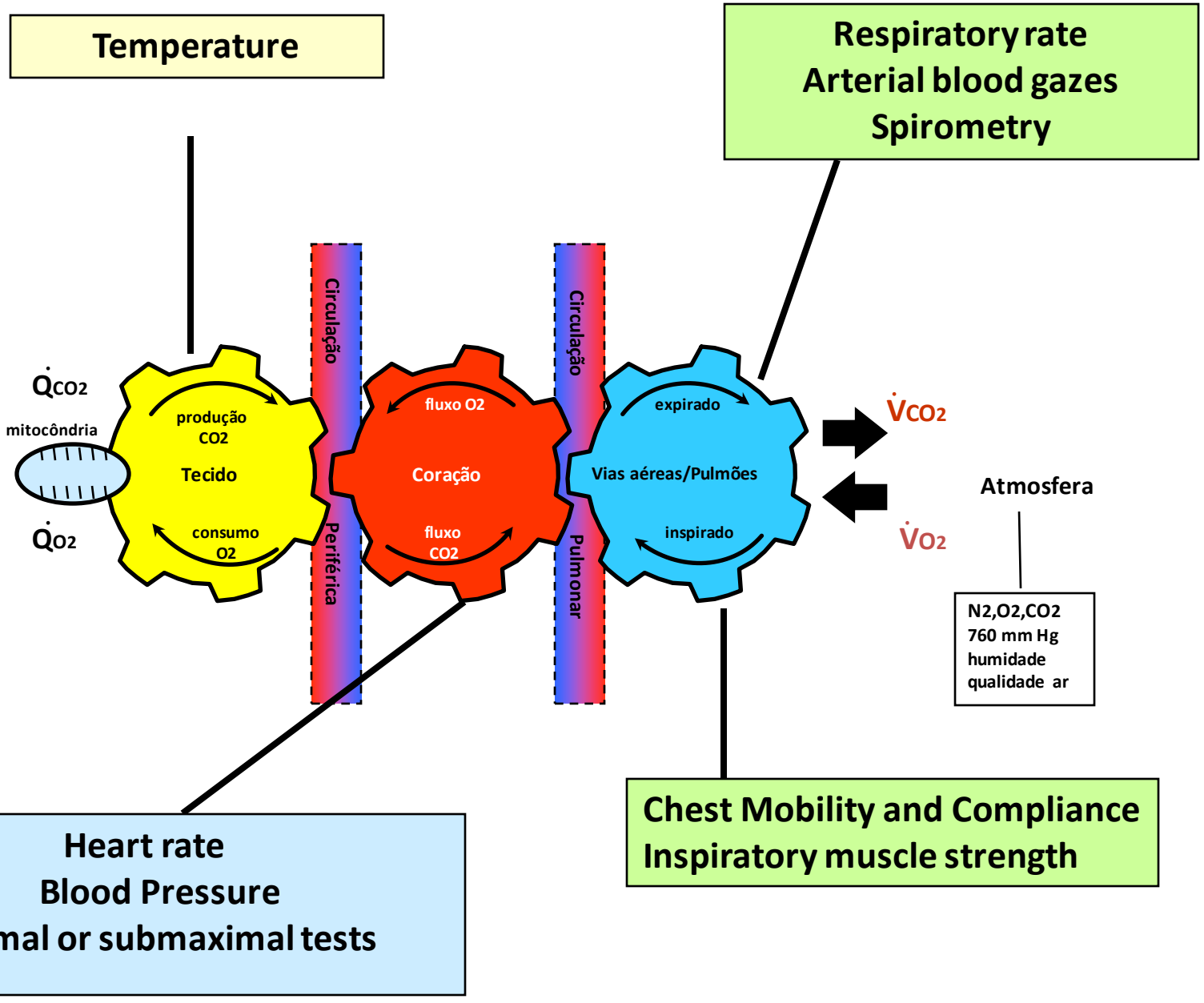
Body function&structure *(Impairment)* ⟷ **Activities** *(Limitation)* ⟷ **Participation** *(Restriction)*



Instruments and Measures

Health Condition
(disorder/disease)

Body function/structure *(Impairment)*	Activities *(Limitation)*	Participação *(Restriction)*
	•Escala de Borg •Índice de dispneia de transição e basal (MAHLER) •Escala de Cotes •Prova 6 Min Marcha •Shuttle Walking Test	•SGRQ •SF-36


Temperature
Respiratory rate
Arterial blood gazes
Spirometry
Circulação
Circulação
$\dot{Q}_{CO2}$
mitocôndria
produção CO2
Tecido
consumo O2
$\dot{Q}_{O2}$
Periférica
fluxo O2
Coração
fluxo CO2
Pulmonar
expirado
Vias aéreas/Pulmões
inspirado
$\dot{V}_{CO2}$
$\dot{V}_{O2}$
Atmosfera
N2,O2,CO2
760 mm Hg
humidade
qualidade ar
Heart rate
Blood Pressure
maximal or submaximal tests
Chest Mobility and Compliance
Inspiratory muscle strength

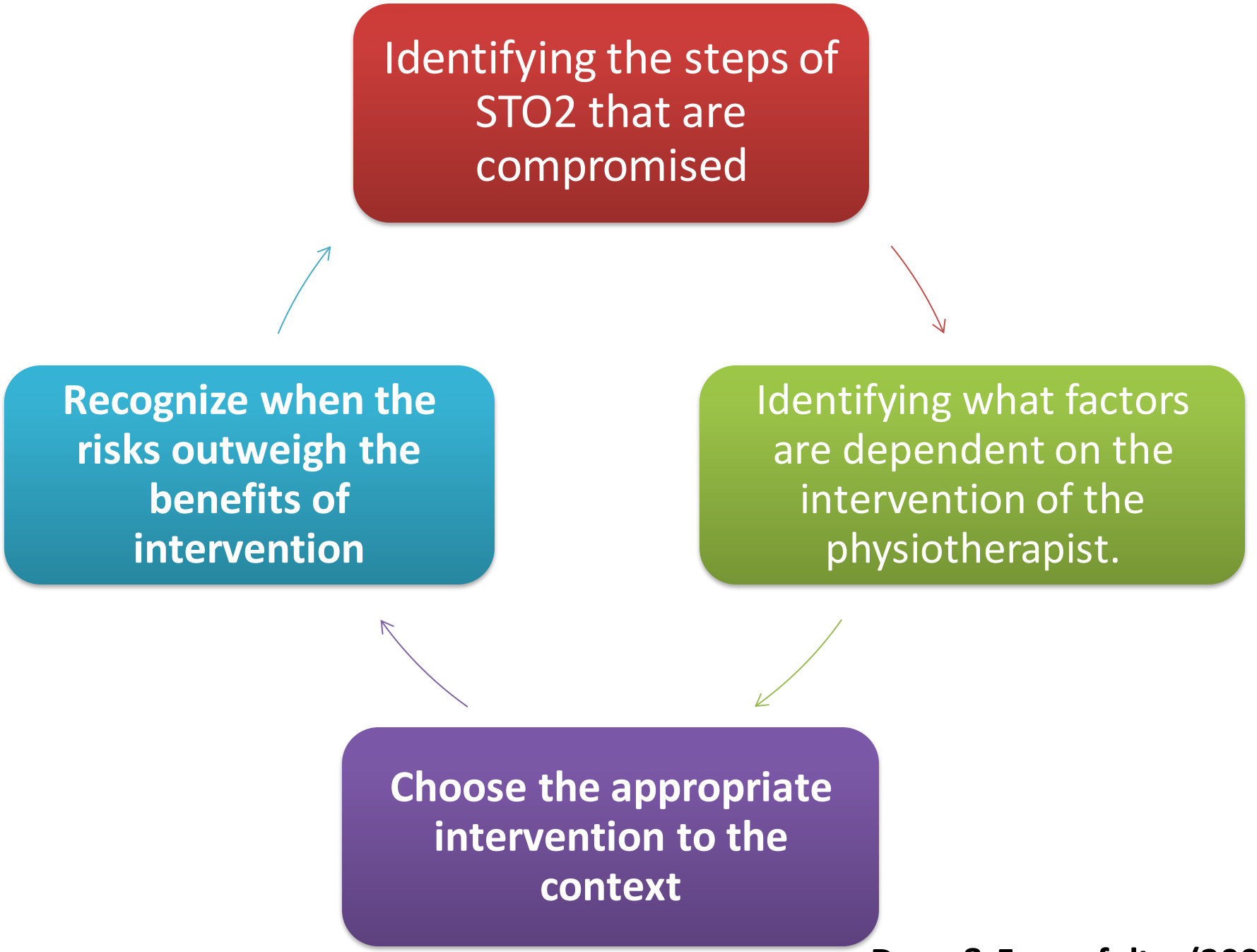
Physiotherapy Process

It is essential that the physical therapist identifies those factors that threaten or contribute to impaired oxygen transport so that the physical therapist can distinguish which impairments are amenable to physical therapy intervention and which are not, or how treatment should be modified.

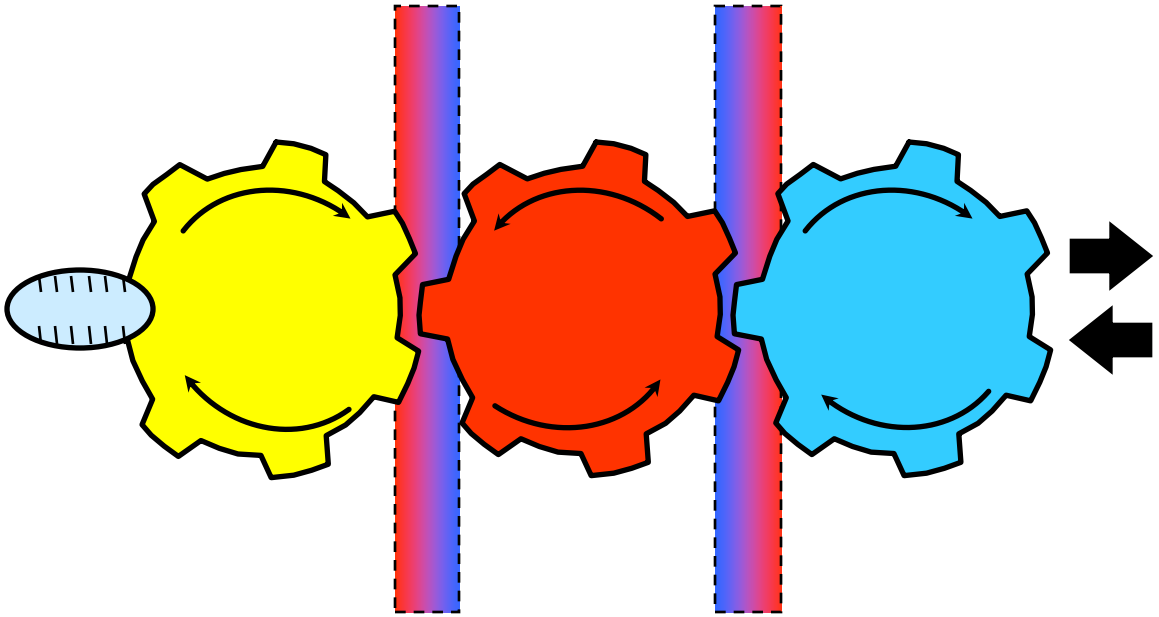
There are 4 categories of factors that threaten or impair oxygen transport:

- **Underlying pathophysiology,**
- **The effects of recumbency and restricted mobility,**
- **External factors directly related to the patient's care**
- **Intrinsic factors directly related to the patient**

Dean & Frownfelter (2006)



Dean & Frownfelter (2006)



- An ability to analyze the contribution or threat of these factors to oxygen transport will ensure that intervention is directed at the underlying impairments, hence, treatment is maximally beneficial and cost effective, and constitutes the least risk and is least costly.

Intervention targets

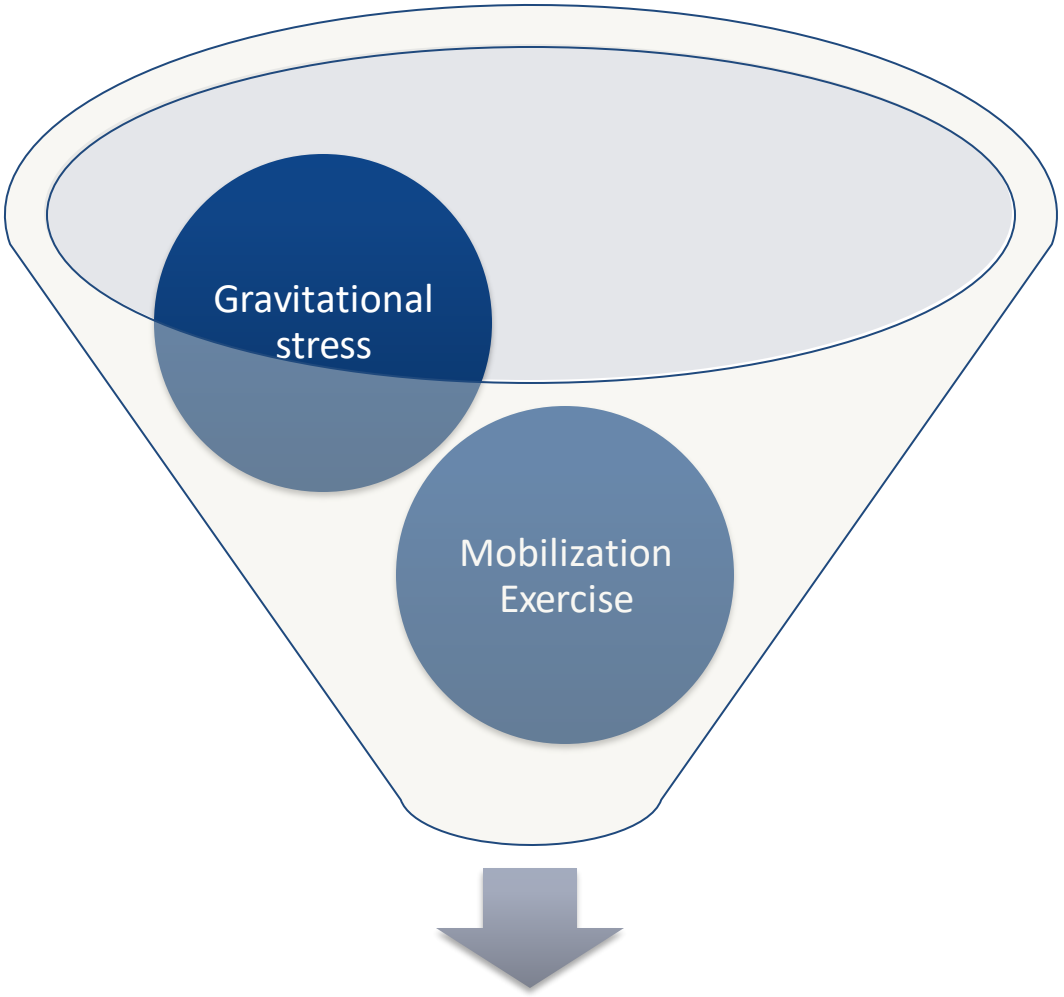
- **Oxygen transport system optimization:**
  - Increase lung volumes and complience
  - Increase of mucus clearence
  - Increase of respiratory muscle strength and chest mobility

Avoid the effects of recumbency and restricted mobility

Promote Daily Living activities

Dean & Frownfelter (2006)

INTERVENTION STRATEGIES



Recumbency and restricted mobility

Consequences off recumbency and restricted mobility

- orthostatic intolerance resulting from the shift of body fluids into the thorax from the extremities and the loss of the stimulus of gravity needed to maintain hemodynamic status in the upright position;
- loss of muscle strength;
- monotonous tidal ventilation
- airway closure, atelectasis, secretion retention
- interstitial fluid accumulation

1 º Premise

The position of optimal physiological function is being upright and moving

2 º Premise

“The best stimulation is one that enhances the oxygen-carrying capacity of the individual and produces the greatest adjustment without causing damage.”

Dean (2006)

Dean's Hierarchy for Treatment of Patients With Impaired Oxygen Transport

- Mobilization and Exercise
- Body Positioning
- Breathing Control Maneuvers
- Coughing Maneuvers
- Relaxation and Energy Conservation Interventions
- ROM Exercises (Cardiopulmonary Indications)
- Manual Techniques
- Suctioning

Dean & Frownfelter (2006)

Mobilization and Exercise

In the context of Cardiopulmonar Physiotherapy the Mobilization refers to a low-intensity exercise

Goal: To elicit an exercise stimulus that addresses one of the three effects on the various steps in the oxygen transport pathway, or some combination:

A. **Acute effects**

B. **Long-term effects**

C. **Preventative effects**

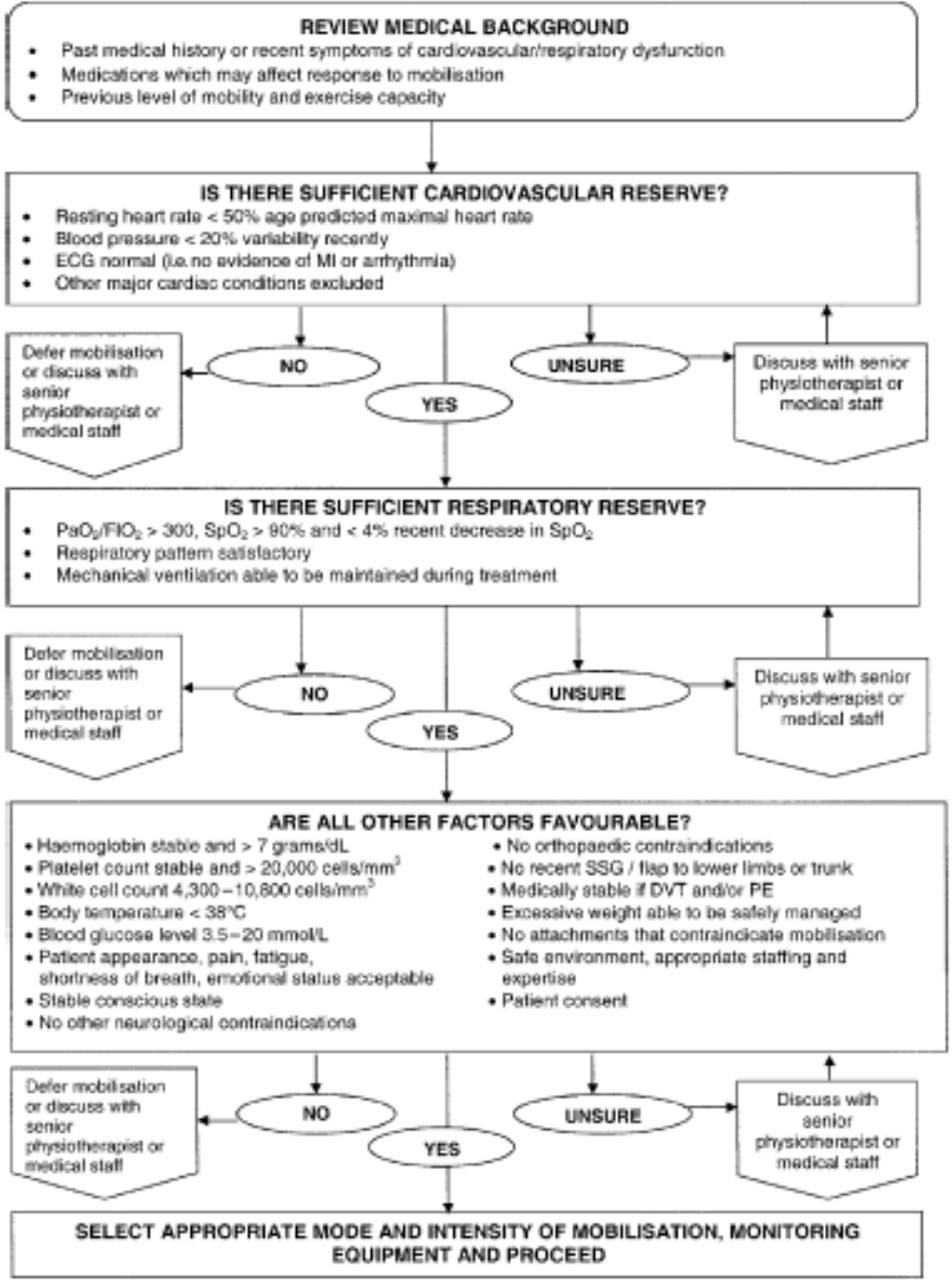


Fig. 1 Overview of safety issues prior to mobilizing acutely ill in-patients (from Stiller and Phillips, 2003).

The safety of mobilisation and its effect on haemodynamic and respiratory status of intensive care patients

Kathy Stiller,
Anna C. Phillips
Paul Lambert

Physiotherapy Theory and Practice, 20, 2004

Body Positioning

Positioning refers to the manipulation of the effect of gravity on cardiovascular and cardiopulmonary functions in order to optimize the transport of oxygen.

Dean (1996)

Body Positioning

Goal: To elicit a gravitational stimulus that simulates being upright and moving as much as possible (ie, active, active assisted, or passive)

•Hemodynamic effects related to fluid shifts;
• Cardiopulmonary effects on ventilation and its distribution, perfusion, ventilation, and perfusion matching and gas exchange;

Dean (2006)

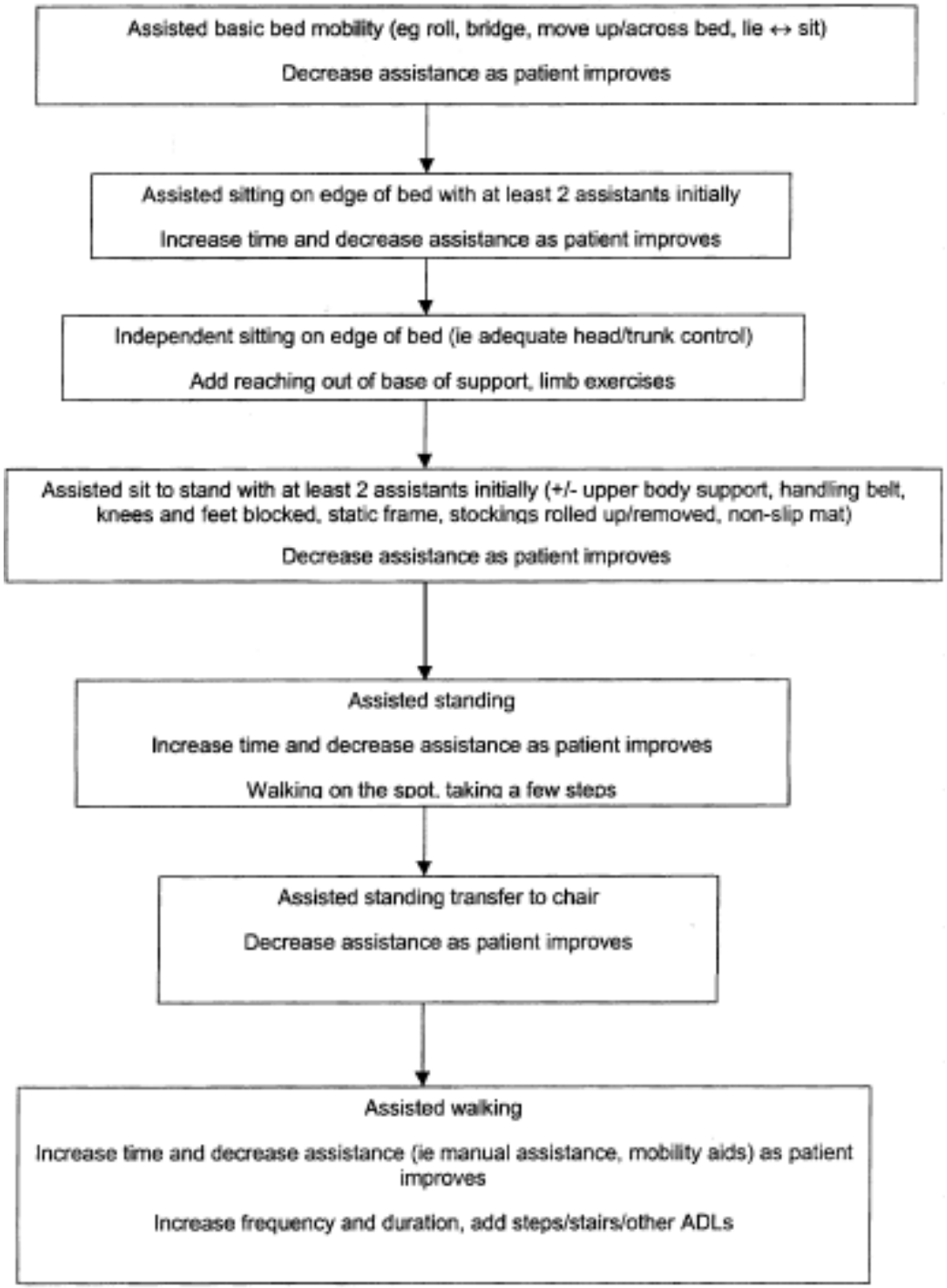
Effect -dependent response

Prescribed

Body Positioning

Rotine Body Positioning

Time -dependent response



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Body Positioning

Body Positioning

Breathing Control Maneuvers

Goal: To augment alveolar ventilation, faciliate mucociliary transport, and stimulate coughing

A. Coordinated breathing with activity and exercise

B. Spontaneous eucapnic hyperventilation

C. Maximal tidal breaths and movement in three dimensions

D. Sustained maximal inspiration

E. Pursed lip breathing to end-tidal expiration

F. Incentive spirometry

Coughing Maneuvers

Goal: To facilitate mucociliary clearance with the least effect on dynamic airway compression and adverse cardiovascular effects:

A. Active and spontaneous cough with closed glottis
B. Active assist (self-supported or by other)
C. Modified coughing interventions with open glottis (eg, forced expiratory technique, huff)

Relaxation and Energy Conservation Interventions

Goal: To minimize the work of breathing, of the heart, and oxygen demand overall

A. Relaxation procedures at rest and during activity

B. Energy conservation (ie, balance of activity to rest, performing activities in an energy-efficient manner, improved movement economy during activity)

C. Pain control interventions

ROM Exercises (Cardiopulmonary Indications)

Goal: To stimulate alveolar ventilation and alter its distribution

A. Active

B. Assisted active

C. Passive

Manual Techniques

Goal: To facilitate airway clearance in conjunction with specific body positioning:

A. Autogenic drainage

B. Manual percussion ???

C. Shaking and vibration ???

D. Deep breathing and coughing

General Guidelines

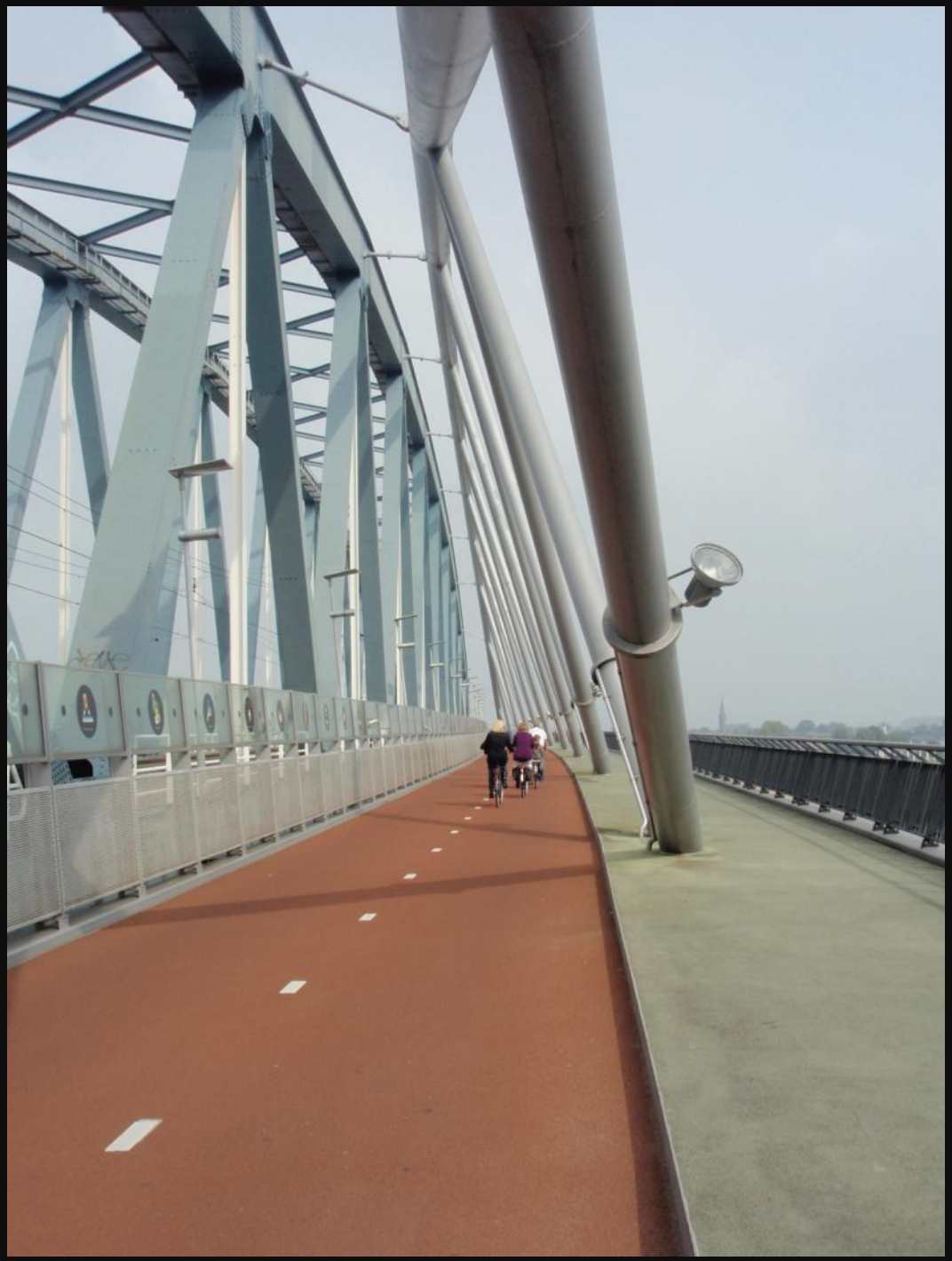
- **Set the duration of the intervention based on the patient's response (changes in the measures and indices of STO2) instead of in time.**
- **Repeat interventions as many times as possible based on the beneficial effects and tolerance of the patient.**
- **Increase the intensity of the stimulus Mob / Exer. and duration of the operation or both, depending on where the patient's ability to maintain an optimum transport of oxygen and maintenance of variables monitorable pre-defined within the margin of safety.**

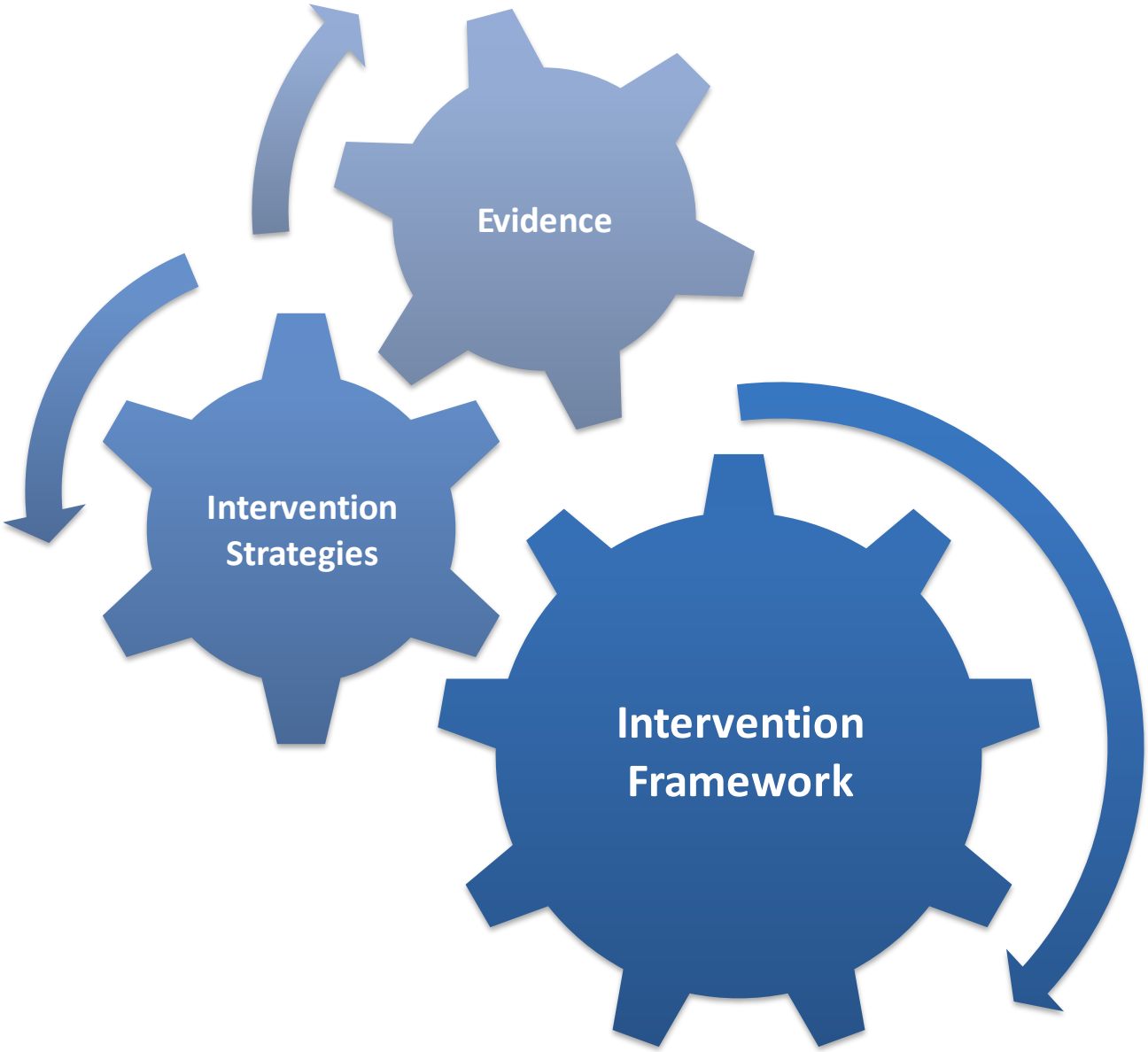











Evidence
Intervention Strategies
Intervention Framework

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•Dean E. Oxygen transport: a physiological ly-based conceptual framework for the practice of cardiopulmonary physiotherapy. Physiother. 1994;80:347-359.

•Wasserman K, Hansen JE, Sue DY, Whipp Bj. Principles of Exercise Testing and Interpretation. Philadelphia, Pa: Lea & Febiger; 1987.

•Dean E. Optimizing treatment prescription. Relating treatment to the underlying pathophysiology. In: Frownfelter D, Dean E (eds). Principles and Practice of Cardiopulmonary Physical Therapy. ed. St. Louis, MO: Mosby; 2006. Dean E, Frownfelter D. Deficits in oxygen transport: The basis for diagnosis and treatment prescription. In: A Clinical Case Study Guide to Accompany Principles and Practice of Cardiopulmonary Physical Therapy. 3rd ed. St. Louis, MO: Mosby; 1996. Dean E. Oxygen transport deficits in systemic disease and implications for physical therapy. Phys Ther. 1997;77:187-202.

•Dean E, Ross J. Mobilization and exercise conditioning. In: Zadai C (ed). Pulmonary Management in Physical Therapy. Clinics in Physical Therapy. New York, NY: Churchill Livingstone: 1992.

•Ross J, Dean E. Body positioning. In: Zadai C (ed). Pulmonary Management in Physical Therapy. Clinics in Physical Therapy. New York, NY: J, Purves S. Improving the validity of clinical exercise testing: the relationship between practice and performance. Arch Phys Med Rehabil. 1989;70:599-604.