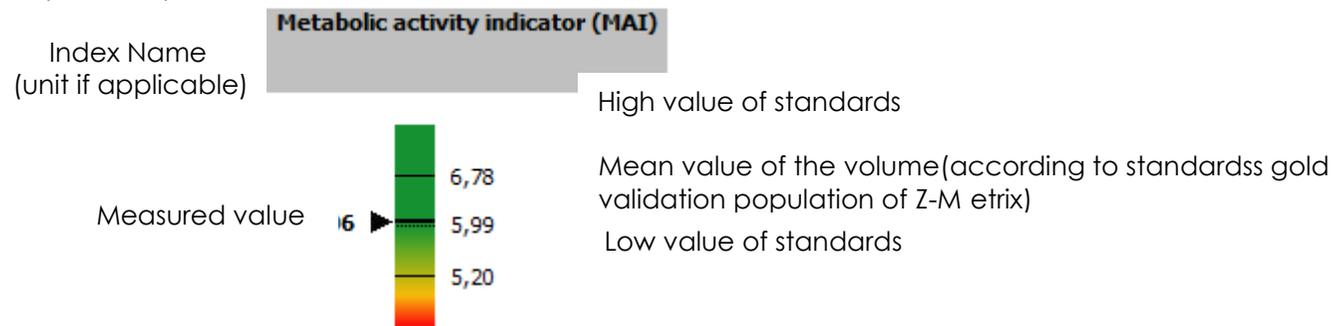


BIOPARHOM Z-METRIX – INDICATORS DESCRIPTION

Bioimpedance is the opposition of a biological tissue to the passage of an electric current. The measurement of electrical data by scanning six frequencies, combined with age (A), height (H), weight (w) and gender, make it possible to calculate all the parameters displayed. Our work on the elderly, adults, adolescents, children, healthy, pathological and sports allows us to have databases dedicated to each type of population and equations adapted and validated for all these populations, standing up and lying down **[1; 2; 3]**.

Each indicator is presented in a gauge format. The values constituting it are specific to the measurement (age, sex, oral body composition data) and therefore to be used to customize your interpretation.



As a reminder, the use of impedance equipment is **prohibited** on people with **implantable active medical devices** such as pacemakers and on **pregnant women**.

In addition, precautions must be taken during measurements in certain patients. Measurement is possible, but a number of factors need to be taken into account when interpreting the data:

- carriers of non-active implants (hip prosthesis for example)
- measurement during a digestion phase or within 24 to 72 hours after intense exertion,
- wearing compression stockings (to be removed at least half an hour before the measurement)
- taking stimulants (caffeine, narcotics,...), food supplements, tobacco or alcohol just before the measurement...
- taking medicines that may change physiological behaviour (corticosteroids, antidepressants, antibiotics)
- excessive drinking just before the measurement
- dry or oily skin.

In women during menstruation, repercussions on the intra/extracellular balance may be analyzed. No other body composition parameters will be impacted thanks to our non-deductive bioimpedance technology. Measurements can be taken without disruption on patients who are amputated, perfused, on a respirator, on dialysis or receiving artificial nutrition.

When measuring a patient lying down, please have the patient lie on an examination table in a horizontal position (less than 15° trunk inclination) for at least 7 minutes before taking the measurement.

The indices of the Expert/Express block are recommended for you to perform your measurements routinely, but you can create as many modules as necessary to allow you to display the indices in line with your practices. To do this, use the **Indicators** tab in the settings.

You are asked to use the "simple assessment" module already created to carry out your first measurements and obtain your few patient cases necessary for your good training. These assessments can be given to patients without the risk of misinterpretation.

Ionic indices are not validated for medical diagnosis.

If the "simple" balance sheet does not exist in your default modules, you can use the following indices:

<input type="checkbox"/> Group	<input type="checkbox"/> Delta weight (kg)	<input checked="" type="checkbox"/> Weight (kg)
<input type="checkbox"/> Profile	<input type="checkbox"/> Ideal weight according to the height and sex	<input checked="" type="checkbox"/> Height (cm)
<input checked="" type="checkbox"/> Body Mass Index (kg/m ²)		
Nutritional metabolism		
<input type="checkbox"/> Level of Physical Activity (SU)	<input checked="" type="checkbox"/> Basal metabolism (Kcal/day)	<input checked="" type="checkbox"/> Energy requirements (Kcal/d)
<input type="checkbox"/> Agresion coefficient	<input type="checkbox"/> Rest energy expenditure calculated by the Lean	
Metabolic data		
<input checked="" type="checkbox"/> Metabolic Activity Indicator (SU)	<input checked="" type="checkbox"/> Active Cell Mass (%W)	<input checked="" type="checkbox"/> Total body protein (kg/m ²)
<input type="checkbox"/> Extracellular Mass (kg)	<input type="checkbox"/> Active Cell Mass (kg/m ²)	<input type="checkbox"/> Protein Content of Active Cell Mass (kg)
<input type="checkbox"/> Extracellular Mass (%W)	<input type="checkbox"/> Total body protein (kg)	<input type="checkbox"/> Protein Content of Active Cell Mass (%W)
<input type="checkbox"/> Body Cell Mass availability	<input type="checkbox"/> Total body protein (%W)	<input type="checkbox"/> Protein Content of Active Cell Mass (kg/m ²)
<input type="checkbox"/> Active Cell Mass (kg)		
Tissular distribution		
<input type="checkbox"/> Fat Free Mass (kg)	<input type="checkbox"/> Lean body Mass (%W)	<input checked="" type="checkbox"/> Muscle Mass Index (kg/m ²)
<input type="checkbox"/> Fat Free Mass (%W)	<input type="checkbox"/> Bone Mineral Content (kg)	<input type="checkbox"/> Fat Mass Index (kg/m ²)
<input type="checkbox"/> Fat Mass (kg)	<input checked="" type="checkbox"/> Bone mineral content (%FFM)	<input checked="" type="checkbox"/> Fat Free Mass Index (kg/m ²)
<input checked="" type="checkbox"/> Fat Mass (%W)	<input type="checkbox"/> Muscle Mass (kg)	<input type="checkbox"/> Lean Body Mass Index (kg/m ²)
<input type="checkbox"/> Lean body Mass (kg)	<input type="checkbox"/> Muscle Mass (%W)	
Fluids data		
<input type="checkbox"/> Total Body Water TWB (L)	<input type="checkbox"/> Extracellular Water ECW (%TBW)	<input type="checkbox"/> Fat Free Mass Hydration (%)
<input checked="" type="checkbox"/> Extraellular Water ECW (L)	<input type="checkbox"/> Body Hydration (%)	
<input checked="" type="checkbox"/> Intracellular Water ICW (litter)	<input type="checkbox"/> Intracellular Water ICW (%TBW)	

1 | Module proposals by patient profiles

Simple detection of adult undernutrition under 70 years of age (collection of HAS criteria only) and overweight/obesity	Weight, height, BMI, fat mass (%), muscle mass index (kg/m ²), non-fat mass index (kg/m ²), Janssen MMA index (kg/m ²)
Simple detection of adult undernutrition over 70 years of age (collection of HAS criteria only) and overweight/obesity	Weight, height, BMI, fat mass (%), muscle mass index (kg/m ²), muscle mass (kg), MMA according to Sergi (kg), MMA index according to Sergi (kg/m ²)
Malnourished or at-risk patients: complete assessment for rehabilitation follow-up / renutrition	Weight, Height, BMI, AMI, Active cell mass (kg/m ²), Body protein content (kg/m ²), Fat mass (kg and % weight) muscle mass (kg and kg/m ²), non-fat mass index (kg/m ²), bone mineral content (% MNG), extracellular water volume in L, intracellular water volume in L.
Patients with sarcopenic obesity or at risk: complete assessment for rehabilitation follow-up / renutrition	Weight, Height, BMI, AMI, Active cell mass (%), Body protein content (kg/m ²), Fat mass (kg and % weight) muscle mass (kg and kg/m ²), non-fat mass index (kg/m ²), bone mineral content (% MNG), extracellular water volume in L, intracellular water volume in L.
Sports	Weight, Height, BMI, AMI, Active cell mass (%), Body protein content (% weight), Fat mass (kg and % weight) muscle mass (kg and % weight), bone mineral content (% MNG), extracellular water volume in L, intracellular water volume in L.
Children	BMI, AMI, Active cell mass in %, Body protein content in %, CMO in kg, Muscle mass in %, Fat mass in %, extracellular water %vt, intracellular water %vt.
Overweight/obese patients	Express (or Expert) template already configured.

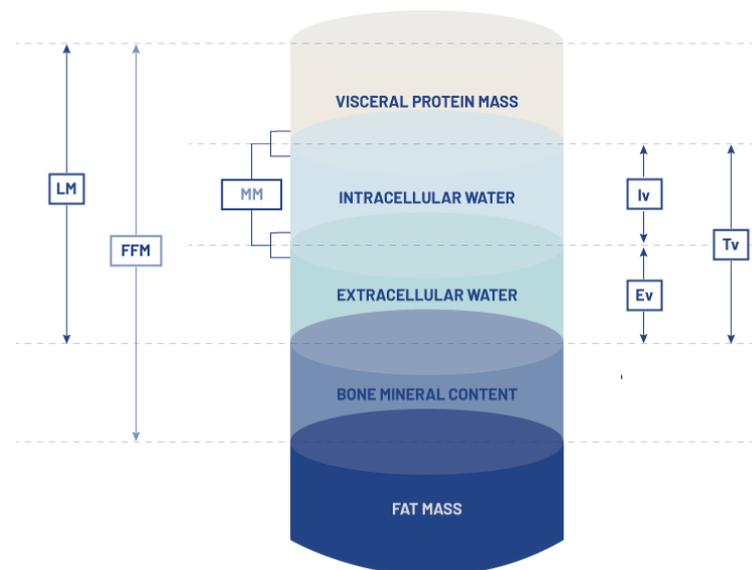
You can select up to 8 indices for the graphs and follow-up measurements. We recommend the 6 indicators: weight (kg), body fat (kg), body protein content (kg), metabolic activity index, extracellular water (L) and intracellular water (L).

2 | General (identity description)

<u>Basal metabolism (MB) in kcal/d</u>	Literature: Harris, Benedict [4]	Basic energy consumption for the functioning of the body at rest: heart, brain, breathing, digestion, maintenance of body temperatures...	
<u>Energy expenditure on rest in kcal/d</u>	Literature: Lam [20]	Energy required to keep the body's biochemical systems at complete rest, calculated on the basis of the measured fat free mass.	
<u>Level of Physical Activity (NAP) without unit</u>	Literature : Martin et al [5]	Allows you to situate the physical activity of a subject in relation to a population	On the order of: (on average in France, 1.56) Sedentary:1.37 Active: 1.55 Athletes: 1.80 High-level & very active: 3 and +
<u>Factor or Level of Aggression without Unit</u>	Translates the impact of a pathology on energy metabolism: 0.8 Person intubated, ventilated 1 No pathology, or no impact on energy metabolism 1.1 Fever, low-grade inflammation 1.2 Progressive cancer, multiple fractures 1.3 Minor surgery, radiotherapy, chemotherapy, moderate undernutrition 1.4 Polytrauma, severe undernutrition 1.5 Severe sepsis 1.6 HIV 1.8 Burns, to be increased by extent		
<u>Energy Requirements (BE) in kcal/d</u>	Literature : Martin et al [5]	Caloric need for the body to maintain a stable body weight	
<u>Body Mass Index (BMI) in kg/m²</u>	Quetelet (1985)	Allows to locate a subject in a population, to detect obesity and undernutrition. Healthy values are between 18.5 and 25; overweight values between 25 and 30; obesity values are above 30.	

As a reminder, Bioparhom uses for the body representation, the model with five compartments validated according to [19].

LM : Lean Mass
FFM : Fat-Free Mass
MM : Muscle Mass
Iv : Intracellular Water Volume
Ev : Extracellular Water Volume
Tv : Total Water Volume



3 | Metabolism (pathology, state of fatigue, state of fitness, prevention of undernutrition and too intensive training)

Indicator	Description	Interpretation	Threshold values	Actions/Correction
Metabolic activity index (IAM) without a unit	<p>Literature: [6; 7; 8] AMI is a prognostic value related to cellular vitality or membrane permeability. It reflects a good ability of the body to eliminate waste, restore osmotic pressure, manage edema, ion and protein transfers. It is related to the explosiveness of the cell in athletes and is related to albuminemia in patients at risk of undernutrition [22].</p> <p>It has been shown that when the IAM decreases, the intrinsic capacity of the membranes crossed increases, which decreases their permeability (ion passages, water molecules ...). It will therefore be more difficult to restore osmotic pressure, to absorb edema...</p>	<p>Allows to know the state of metabolic form/fatigue of the patient: <u>If low or decreasing</u>: tired, weakened, sleepless, overworked, nutritional deficiencies, serious pathologies. <u>If normal or high</u>: patient in shape, cellular exchanges are not impacted.</p>	<p><u>Low threshold</u>: <= to 4.5 Under 3.5, the patient's risk of death increases by 50%.</p> <p><u>Healthy subject</u>: Men: 6-8 Women: 5-7 Athletes: 8-10 The value during the 1st measurement is to be placed in its context. A person with an IAM of 6 may very well feel tired right now, a sign that their basic IAM is higher.</p>	<p><u>From normal to high</u>: balanced diet with adapted physical activity. <u>So low</u>: increase the intake of starchy foods / fruits and vegetables / proteins / food supplements: vitamins of group B, vitamin C, magnesium, essential amino acids, favor rest phases, work on sources of stress and improve the quality of sleep.</p>
Active Cell Mass (ACM) Kotler method as % by weight	<p>Literature: Kotler et al. [9] Varlet et al. [10] Kotler discusses this cell mass in relation to its potassium content and gives us the MCAK index. Represents the cell mass containing proteins, intracellular water, minerals and polysaccharides. This active cell mass constitutes metabolic activity and participates in biochemical processes and energy metabolisms. Nutritional status, level of physical activity and disease alter ACM, which can serve as biomarkers for this type of process. "In the athlete, it would make it possible to gauge the level of training or malform of the athlete", via his capacity in endurance.</p>	<p>Reflection of the overall lifestyle: sleep, diet, physical activity. Active Cell Mass is correlated with the aerobic potential and recovery potential of patients after disease. <u>If low</u>: patient with depleted cellular content OR/AND lack of physical activity. <u>If medium to high</u>: Patient with a potential for the right effort.</p>	<p><u>If low values</u>: If less than 30% in women and 35% in men: risk of undernutrition according to Barbosa-Silva [17] to correlate with muscle mass and / or non-fat mass. Limited patient fitness potential. Example of a person overweight by excess fat mass. The MCA will increase with the practice of regular and enduring physical activity and will increase all the more with the loss of fat mass in parallel. Lighter, the patient gains endurance.</p>	<p><u>If normal to high</u>: Maintain a healthy lifestyle in place: physical activity, nutritional and water intake.</p> <p><u>So low</u>: set up a balanced diet and adapted aerobic physical activity / food supplements: vitamins of group B, vitamin C, omega 3 and 6, iron, ginseng.</p>

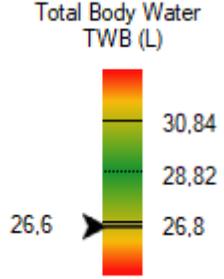
<p><u>Protein Content of the Body (CPC) in kg/m².</u></p>	<p>Literature: Wang et al. [11] Allows to estimate the body protein amount in order to supplement if necessary the subject's diet</p>	<p>Index that makes it possible to know the body's protein reserves and to make the necessary nutritional corrections.</p>	<p><u>If low or declining values</u> : low protein intake or cachectizing pathology.</p> <p><u>If average values</u>: protein intake that meets the physiological needs of the patient.</p> <p><u>If high values</u>: correlation to be made with muscle mass or too much intake.</p>	<p><u>Whether low or decreasing</u> : increase the intake of animal and / or vegetable protein in several doses per day and of good quality and diversity. <u>So high</u>: evaluate the intake of vegetable and / or animal proteins of the subject and consider maintaining or reducing intake.</p>
<p><u>Protein Content of Active Cell Mass (CPMCA) in kg/m².</u></p>	<p>Literature: Wang et al. [11] Allows to estimate the protein quantity of the active cell mass in order to evaluate the quality of the intakes, their diversity and their absorption.</p>	<p>Index that makes it possible to know the ability to assimilate the ingested proteins.</p>	<p><u>If low or down values</u>: Subject who may have roteic malabsorption if the CPC value is normal or poor assimilation. <u>If medium or high values</u>: value to correlate with the CPC.</p>	<p><u>So low</u>: work on nutritional assimilation (intestines, stomach ...) , related to cellular vitality. <u>So high</u>: evaluate the intake of vegetable and / or animal proteins of the subject and consider maintaining or reducing intake.</p>

4 | Tissues (management of fat, muscle and bone mass, detection of undernutrition and sarcopenia)

Indicator	Description	Interpretation	Threshold values	Actions/Corrections
<p><u>Fat mass (MG) kg and % by weight</u></p>	<p>Calculations with our own multivariate regression equations validated by our clinical study. Allows to estimate the fat mass of the body. Literature:[1]</p>	<p>To be realized with the value in % : <u>If in the norms:</u> amount of fat mass in the standards of good health.</p> <p><u>If below the standards:</u> insufficient fat mass.</p> <p><u>If between high gauge and high gauge + 5%:</u> fat mass in overweight standards.</p> <p><u>If above high gauge +5%:</u> fat mass in obesity standards.</p> <div data-bbox="779 683 1120 981" data-label="Figure"> </div>	<p> The data present in the Fat Mass gauge as % of weight are the healthy values determined by the Obesity Research Institute and Gallagher [18]. They are specific to the subject (gender and age). The fat mass value in kg is an average population by sex regardless of age. It is therefore only used for monitoring measures.</p> <p> In sport mode: the reference values are averages of athletes; all disciplines combined</p>	<p><u>If low:</u> ensure THE GA intake to optimize the functioning of cell membranes. Normal and balanced diet.</p> <p><u>So high :</u> set up an appropriate diet for a loss of fat mass, associated with adapted physical activity.</p>
<p><u>Bone Mineral Content (CMO) in %MNG</u></p>	<p>Calculations with our own multivariate regression equations validated by our clinical study. Allows you to estimate bone quality. Literature: [1]</p>	<p>Index that allows to know the measured bone quality.</p> <p>A low indicator may be a sign of a risk of osteoporosis; conversely, a high indicator will be a sign of good bone quality.</p> <p>In subjects with BMI>30, a high value should be measured, to limit the risk of osteoporosis.</p>	<p> <u>Aids in the diagnosis of osteoporosis:</u> value approaching the low value of the gauge</p> <p><u>Subject with normal to high bone mineral content:</u> values in the green</p>	<p><u>If low:</u> check calcium deficiency and Vitamin D / food supplements: calcium, magnesium, potassium, phosphorus, vitamins C, D, E.</p> <p><u>If normal to high:</u> Maintain this state by monitoring dietary intakes of calcium, vitamin D, phosphorus and fluoride and keep regular physical activity.</p>

<p><u>Muscle Mass (MMus) in Kg and kg/m²</u></p>	<p>Literature: Wang's work validated by MRI [12] Allows to estimate the muscle mass of the body, composed mainly of water and proteins, particular attention for the interpretation must be given to water variations.</p>	<p>To be carried out with the index value (kg/m²): <u>If low or decreasing:</u> subject with low muscle mass (beware of sarcopenia, undernutrition, cachectizing pathology). <u>If medium:</u> can be expanded/increased <u>So high:</u> subject with a good muscle constitution.</p>	<p> <u>In adults under 70 years of age:</u> <u>If ≤ 5.7 kg/m² in women and ≤ 7 kg/m² in men:</u> the subject is sarcopenic according to the GLIM recommendations [13]  The value in kg is an average population by sex regardless of age. It is useful for monitoring measures.  <u>In adults over 70 years of age:</u> <u>If ≤ 5.5 kg/m² or < 15kg in women and ≤ 7 kg/m² or < 20kg in men:</u> risk of undernutrition. Here, sarcopenia is only proven if there is also a loss of muscle strength [21] <u>If normal to high:</u> sufficient muscle mass.</p>	<p><u>If below the lower threshold:</u> Detect undernutrition by searching for an etiological criterion and/or assessing muscle strength [13] [21] Increase protein intake and fluid intake if necessary. Set up an adapted physical activity to maintain this value, and at best increase it. <u>If average:</u> monitor protein intake or even adapt it to help increase via physical activity. <u>So high:</u> maintain protein intake and physical activity.</p>
<p><u>Non-Fat Mass (MNG) in kg/m²</u></p>	<p>Non-fat mass represents body weight – fat mass. It therefore includes all other compartments (proteins, total water, CMO). Particular attention should be paid to interpretation of water variations.</p>	<p>To be carried out with the index value (kg/m²): <u>Whether low or decreasing:</u> indicates a patient's low nutritional status <u>If medium or high :</u> Subject with a satisfactory nutritional status.</p>	<p> <u>If ≤ 15 in women and ≤ 17 in men:</u> the subject is malnourished according to the GLIM recommendations [13] (age 18-69 years old) <u>So normal to high:</u> nutritional status satisfactory to maintain.</p>	<p><u>If low:</u> Detect undernutrition. Increase protein intake if necessary. Set up an adapted physical activity. <u>If medium to high :</u> maintain protein intake and physical activity.</p>
<p><u>Appendicular Muscle Mass (AMM) in kg and in kg/m².</u></p>	<p>GLIM Criteria for the diagnosis of malnutrition [23]</p>	<p>Choose AMM Janssen in kg/m² for subjects aged 18 to 69. Choose AMM Sergi in kg and kg/m² for subjects aged 70 and over.</p>	<p> <u>In adults under 70:</u> <u>If ≤ 5.7 kg/m² in women and ≤ 7 kg/m² in men:</u> the subject is sarcopenic according to GLIM recommendations [13]  <u>In adults aged 70 and over:</u> <u>If ≤ 5.5 kg/m² or < 15kg in women and ≤ 7 kg/m² or < 20kg in men:</u> risk of undernutrition. In this case, sarcopenia is only confirmed if there is also a loss of muscle strength. [21]</p>	<p><u>If low:</u> Detect undernutrition. Increase protein intake if necessary. Set up an adapted physical activity. <u>If medium to high :</u> maintain protein intake and physical activity.</p>

5 | Fluids (management of hydration, water overloads or deficits)

Indicator	Description	Interpretation	Threshold values	Actions/Corrections
<p><u>Total water volume (Vt) in litres and/or Hydration of MNG in %</u></p>	<p>Total body water expressed in L or % of non-fat mass (weight without fat mass that contains very little water) Literature: [14]</p>	<p>The value of the middle of the gauge is the exact value of the person's healthy hydration. The value can be read in L or %. To measure the value of overhydration or dehydration, it is necessary to differentiate between the measured value and the value of the medium of the gauge.</p>  <p style="text-align: center;">Total Body Water TWB (L)</p> <p style="text-align: center;">30,84 28,82 26,8 26,6</p>	<p>All the threshold values of the hydration indices are specific to the measurement (age, sex, body composition data) and therefore to be used 100% to customize your interpretation.</p>	<p><u>If low:</u> check the quality of the drinks consumed. Ensure water intake during the day. Increase if necessary up to 2L per day.</p> <p><u>So high :</u> quantify the daily intake, set up gentle diuretics if adapted.</p>
<p><u>Volume of extracellular water (Ve) in litres</u></p>	<p>Equation from our research which does not assume that the intra and extracellular compartments are completely independent but that they act as communicating vessels Literature: [2; 15; 16]</p>	<p>Extracellular water is considered to be the water reserve , recently brought in and not yet passed into intracellular. <u>If low:</u> subject with a risk of extracellular dehydration, the intakes are insufficient. <u>So high:</u> subject with a risk of water retention in extracellular, which can be associated with venous insufficiency, a diet too rich in sodium. To correlate with the index of metabolic activity.</p>	<p></p>	<p><u>If low:</u> Increase water intake over the day. <u>So high:</u> Make an assessment of water intake and if it seems too important, gradually reduce it.</p>
<p><u>Volume of intracellular water (Vi) in litres</u></p>	<p></p>	<p>Intracellular water is the so-called functional water, used for cellular functioning, energy production, waste disposal... <u>If low:</u> subject with a risk of intracellular dehydration that may result for example from insufficient intakes or low AML. <u>If high:</u> subject with a risk of intracellular water retention, Potential causes: hormonal disorder, measurement in the post-prandial period, post physical activity or during menstruation, renal and / or cardiac function disorders, taking anabolic food supplements promoting water storage (example of spirulina).</p>	<p></p>	<p><u>If low:</u> Increase water intake over the day. 🚰 Optimize hydration during exercise and in the recovery phase. <u>If high:</u> Resolve the cause of intracellular edema and/or use a light diuretic. 🚰 In athletes, intracellular hyperhydration may be linked to recovery edema</p>

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