

# Supplementary 1 - Building of the preoperative equation for nutritional and physical risk calculations

## Equation 1.1

This equation introduces the preoperative nutritional and physical risk of the patient undergoing elective orthopedic surgery.

$$R = SO \times PH$$

R = risk  
SO = severity of consequences  
PH = probability of occurrence of the hazard

The assignment of the severity score of consequences (SO) is arbitrary. For instance, it can follow a three-point (1, mild consequences, limited in time, no readmission; 2, severe consequences, readmission; 3, highly severe consequences, death or permanent damage) or four-point scale (1, negligible; 2, marginal; 3, critical; 4, catastrophic). The probability of occurrence of the hazard (PH) should conversely be referred to data literature or personal experience on the field similarly to hazard identification. According to the likelihood of occurrence, the PH can follow a three-point (1, unlikely, occurs rarely; 2, probable; 3, very likely, occurs frequently) or a five-point scale (1, improbable; 2, remote; 3, occasional; 4, probable; 5, frequent). It is also important to consider the direction and strength of the association, relying on weighted statistics from prospective relative risk analysis, retrospective odds ratio analysis, and Receiver Operating Characteristic (ROC) analysis.

It is not important which scale for SO and PH are chosen as long as the ranges of acceptability from the equation are adapted accordingly. Considering, for instance, a three-point scale for both SO and PH, then the derived risks would score between 1 and 9: low (1 to 3), medium (4 to 6), or high (from 7 to 9). Different scoring scales will result in different ranges of risks. As demonstrated, the risk of can never score 0.

## Equation 1.2

In orthopedic patients, it is important to consider instead other factors influencing the R, like conditions of vulnerability or environmental pressures, which might expose the patient to increased risks for adverse outcomes (see the following **Table S1**). It is not possible to manage all these factors within the preoperative period, but they must be counted and included in the calculation of the R.

**Table S1** Examples of non-modifiable aspects that increase the risk related to the hazardous malnutrition and physical inability.

Vulnerable condition ( $\tau$ )	Burden ( $\varphi$ )	Root cause ( $\alpha$ )
Aging	War	Bad governance
Poverty	Pain	Underdevelopment
Food insecurity	Illiteracy	
Lack of awareness	Lockdown	
Unsafe environment	Civil disorders	

The score assignment is again arbitrary, and can change at the discretion of the setting or the operator. For instance, it is possible to rate 1 point each factor in **Table S1**, or consider different

scores depending on the psycho-physical impact on the patient (e.g. aging = 1, war = 2). The more relevant and numerous these conditions are and the greater is the risk. The integrated equation is reported below. We suggest the inclusion of these variables in the equation as multiplicative of one towards the other, as very often the concomitance of more than one of these conditions, such as aging, pain, and food insecurity, considerably aggravates the risk of malnutrition and physical disability more than the single factors added together.

$$R = SO \times PH + [\sum(\tau) \times \sum(\varphi) \times \sum(\alpha)]$$

R =	risk
SO =	severity of consequences
PH =	probability of occurrence of the hazard
$\sum(\tau)$ =	summation of each vulnerable condition called tau factor from Greek "τρωτό" ( <i>trotó</i> , vulnerability)
$\sum(\varphi)$ =	summation of each burden called phi factor from Greek "φορτίο" ( <i>fortío</i> , burden)
$\sum(\alpha)$ =	summation of each root cause called alpha factor from Greek "αγένεια" ( <i>agéneia</i> , incivility)

### Equation 1.3

The next step is the estimation of two further factors to complete the risk analysis: the efficacy of the corrective procedures ( $\beta$ ) and efficiency of personnel ( $\varepsilon$ ). The former reflects the impact of the corrective procedures and the second depends on the level of staff information/education, which influences the proper execution of procedures. The more effective the interventions and the higher the level of staff training, the lower is the R. The integrated equation is the following.

$$R = [(SO \times PH) \div (\beta + \varepsilon)] + [\sum(\tau) \times \sum(\varphi) \times \sum(\alpha)]$$

R =	risk
SO =	severity of consequences
PH =	probability of occurrence of the hazard
$\beta$ =	beta factor from Greek "βελτίωση" ( <i>veltíosi</i> , improvement), which depends on the efficacy of interventions
$\varepsilon$ =	epsilon factor from Greek "εκπαίδευση" ( <i>ekpaídefsi</i> , education), which depends on staff training
$\sum(\tau)$ =	summation of each vulnerable condition called tau factor from Greek "τρωτό" ( <i>trotó</i> , vulnerability)
$\sum(\varphi)$ =	summation of each burden called phi factor from Greek "φορτίο" ( <i>fortío</i> , burden)
$\sum(\alpha)$ =	summation of each root cause called alpha factor from Greek "αγένεια" ( <i>agéneia</i> , incivility)