In the clinical management of the artistic voice it is important to identify all the risk components of vocal fatigue or glottic damage.

The choice of repertoires unsuited to technical and vocal features, inadequate work planning, phonatory behaviours tending to hyperkinesis with very high total phonation times, due to amount of voicing during rehearsals, performances, breaks, teaching, private life, a lifestyle that does not include a regular diet, regular sleep-wake cycles, use of drugs or doping substances, the environment in which it takes place the voice activity are all factors that increase the risk of performing complications. For this reason it is essential to predict and to assess the vocal cost of the various vocal performances to avoid any risk of glottic damage.

I’m going to explain very fast the work produced on professional singers in theatres, showing clarifying examples of methods reliability.

In a first period, we examined opera and musical singers using a method we have developed. The first part of the investigation was to evaluate singers’ feeling about characters’ features making interviews before analysis to assess accordance between subjective feeling and objective analysis, interviews after analysis to evaluate the reliability of a predictive evaluation and an accurate anamnesis to find relationships between the patient's medical history, such as any vocal desease or phonosurgery, and results of the analysis.

We used VOCAL SCORE PROFILE, a statistic method for semeiotic of complete vocal score or partitura. It’s made counting presence of NOTES FOR EACH SEMITONE in vocal score. Here is a comparison regarding two different female roles in mozart’s don giovanni: donna Anna and donna elvira.

It is possible to obtain percentages of presences for every tonal range such as low, middle, passage, high, prevalent octave and comfortable ranges. Here are two istograms for the comparison of the same previous roles.

Using percentage of presence of notes for each semiton, we created an histogram called vocal score profile or partiturogram: below we can observe the tonal range semiton by semiton and on the right or on the left the percentage of presence. Here we have vocal score profile for donna anna role. In this case we can note an high presence of middle, passage and high notes, a prevalent octave from A3 to A4 and a little percentage of presence of comfortable range notes. So we can confirm that this is a really difficult role, suitable to a lyric soprano.

We made a voice range profile in a liric soprano, usual performer of this two roles in many important theatres under famous conductors. As you know VRP points out dynamic and frequency range of singers voice.

Anyway it’s better to consider the Dynamic Agility, which is the value of differential between forte and piano calculated for each tone and allows to accurately value the phonation system capacity all range long. In this case we see a decreasing dynamic agility since middle tonal sector and a worsening in passage and high sectors.

Superimposing the dynamic agility graphs on vocal score profile graphs, we obtain a graph (we called P/P rate) that gives a synoptic summary of suitableness of examined singers’ vocal and technical features in regard to considered roles, revealing the hardest and critical moments for the singer eventually causing higher vocal effort or injury risks. Below there is the tonal range, on the right the dynamic agility in dB and on the left the percentage of presence of notes.

We note that in role critical zones, middle, passage and high ranges there’s an evident reduction of dynamic agility, revealing an high risk of vocal effort. The singers noticed that it’s a difficult role,
especially for high and passage notes and is more fatiguing than donna Elvira, the other soprano role in don Giovanni of Mozart.

10) In her feeling, the first act is easier than the second. If we analyze graphs for each act we can point out this feeling: in fact in second act there’s an higher presence of passage and high notes, which make the part more difficult than in first act.

11) Here we have graphs regarding donna Elvira role: we clearly point out that the lower presence of passage and high notes makes the role more accessible and easier for the vocal features of this soprano. We conducted several tests of this type on many singers, 15 opera and 8 musical, but, for obvious timeless we can’t report.

12) However, we revealed that
   • P/P rate is a reliable method to identify a suitable repertoire and to predict performance risks for vocal effort or glottal damage in performing unsuitable roles
   • In low female voices it’s necessary always to evaluate both low and high vocal registers passages.
   • There is a precisely accordance between subjective singers’ feeling and objective analysis
   • There’s the possibility and reliability of a predictive evaluation, even if without knowledge of subjective feeling
   • We can find a relationship between the patient’s medical history, like any vocal disease (even if unknown) or phonosurgery, and analysis results.

13) It’s very important to underline that a singer with unsuited dynamic agility to a specific role can all the same excel in performing it, even if with a HIGHER VOCAL COST. The lyric soprano previously analyzed has sung donna anna role more than 1 hundred times on stage in many important theatres under prestigious conductions, sign of a good performance in that role, but with the final result consisting in phonosurgery and a current vocal folds damage.

14) Later we started to make dosimetries on opera and musical singers during live performances in theatres, using the APM model 3200 on 15 singers, 6 opera and 9 musical singers.

15) Our aim was to evaluate phonatory behavior before, during and after the performances to determine the actual amount of vocal load and therefore the possibility to assess vocal fatigue and performative potential risks through the identification of a vocal fatigue or vocal recovery index. In the future it would be desirable to establish vocal fatigue or vocal recovery thresholds for a reference in the evaluation of data from the dosimetries. Because of time I’m going to describe only some case studies.

16) Initially we conducted a preliminary assessment by anamnesis, tonal audiometry, videolaringostroboscopy and interviews to describe their feelings about the role by examining different points of the vocal score, to identify the most difficult and fatiguing moments and rest time.

17) We consider now two famous tenors who have performed at teatro alla scala in milan 2 different roles in two operas by Verdi: Radames in Aida and Jacopo Foscari in I 2 Foscari.

18) In the first example we can see the Examination of Radames tenor: the total length of the representation is 3 hours and 36 minutes for a PT about 44 min.
19) During the interview, the singer has revealed that the most difficult moment of the entire opera is the beginning of the first act, corresponding to the aria Celeste Aida. The values of F0 and average amplitude are much higher.

20) Analyzing the time of the break between 2nd and 3rd Act and non singing part During beginning of 3rd Act, when it is assumed that there is no phonatory fatigue, but tendency to vocal recovery, we note a marked reduction of Average F0 and amplitude. From phonation density graph we can point out speech and soft phonation trend.

21) Similar considerations for the second tenor: warming up

22) and most difficult and fatiguing moment, the aria in first act

23) We can then make comparisons between the two tenors: the phonation time profile of the warm-up and first act shows that the profile of the first tenore is broken, a sign that he tends to rest and needs less warming-up than the latter, that instead works more with increased risks of voice fatigue.

24) The Fundamental frequency histogram Could Be Considered Such as a real vocal score profile. Here we see a substantial equality between the two tenors, a sign that the roles of the two operas have the same musical characteristics in the first act,

25) as also evidenced by the histogram profile of the vocal score profile.

26) The SPL histogram, however, could be Considered as Such as an on stage relative dynamic agility. In this case the first tenor has a wider range of SPL compared to the 2nd tenor, which uses high SPL for longer, a sign of higher vocal fatigue.

27) The phonation density graph is like a phonetogram and can point out the vocal, technical and behavioral features. The 1st tenor has a wider phonetographic range in all vocal sectors, has a wider range in speech and soft phonation sector than the latter. In a 2006 study Abaza and Carrol Found That Inability to produce soft phonation Increases When vocal effort is present. In this case the chart can show a very small range of speech and soft phonation in the 2nd tenor, even this sign of an increased vocal effort.

28) We had some difficulties: the size of APM is too large and cause discomfort to the dance and stage movements. The costumes are often too tight and it’s impossible to hide the tool. Often the singers do not feel safe to go on stage with discomfort and then refuse to wear it. We must clarify how to perform initial calibration in case of those singers who use both classical and modern way to sing during the same performance. Finally, the literature is still poor and so there are not many references

29) In conclusion we can say that:
• Opera soloist singers make 2-3 performances a week and Rehearsals with a total sung phonation time less than 5 hours a week. This would allow us to say that there is a greater likelihood of damage from acute fatigue
• Musical soloist singers make 8-9 performances a week, Rehearsals and Often hard bodily fatigue in dancing with a total sung phonation time More than 10 hours a week. In this case there would be a greater likelihood of damage from chronic fatigue
30) Through this method it could be possible to adapt technical and behavioral Measures to avoid or reduce the risk of vocal fatigue or damage

• we must still understand whether the technique and voice features Influence vocal dose parameters; for this would be useful to implement the dosimetry for the same role in different singers

• We need more studies to Establish standard fatigue and recovery thresholds and ranges and to assess the possible differences between males and females and Between Different vocal classes