PREVENTION OF UPPER RESPIRATORY TRACT INFECTIONS IN ATHLETES

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INTRODUCTION

When an athlete arrives to compete at a major sporting event, such as the Olympic or Paralympic Games, one of the most common reasons they will seek input from a sports and exercise medicine (SEM) clinician is to deal with is an upper respiratory tract infection (URTi). This medical issue appears to effect between 3-7% of athletes and has the potential to negatively impact performance[1,2]. For the clinical team looking after an athlete with a URTi, there is a need to administer prompt treatment, evaluate risk associated with ongoing sporting participation and to protect others in the team. There is also the question of whether more could have been done to protect the athlete from developing this issue, in the first place. Moreover, some athletes appear to exhibit a propensity to URTi. This can lead to interrupted training and failure for competition selection +/- loss of funding. The role of the SEM team is therefore not only to assess and treat acute URTis, but also to consider the potential factors underpinning susceptibility or a tendency to this issue and thus to act to help protect and maintain athlete health.

In this article, we discuss the key factors underpinning high quality care in this area, drawing on our experience working with elite athletic squads. Rather than providing a comprehensive review, we present a pragmatic, real-world perspective and signpost readers to key references, for further insight.

WHY DO ATHELTES DEVELOP URTi?

In order to consider factors that may 'prevent' URTi in athletes, it is important to consider why an URTi occurs and thus to identify potentially 'modifiable' risk factors. In this respect, when trying to explain why an athlete develops an URTi, there often appears to be focus on trying to unearth some novel or complex exercise or sport-related immune dysregulation or perturbation. In reality, it is likely that many of the risk factors observed in the general population, are equally pertinent, but often overlooked, when considering why athletes develop URTi. Indeed, some have challenged the legitimacy of claims that vigorous exercise creates an 'open window' with immune dysregulation leading to infection[3].

As in the general population, an URTi in an athlete develops as the clinical outcome of an interplay between host and pathogen. Most URTis in athletes are caused by viruses (>80%), with epidemiological studies indicating that these represent the known pathogen profiles circulating in the general community at the time, e.g. rhino, adeno or common coronaviruses. Thus 'exposure' risk factors are highly relevant. As such, factors associated with heightened exposure (e.g. an athlete with young children in their house) and close proximity (e.g. during plane travel) +/- have frequent contact with members of the public (e.g. during interviews / media-related events), act to increase cumulative pathogen exposure risk[4].

The importance of pathogen exposure, as a major factor in URTi, is supported by studies demonstrating the almost complete absence ofURTi during international sporting events, during the COVID-19 pandemic period[5]. Moreover, more recent studies show that elite athletes frequently develop URTi in the 'pre' competition period and thus often travel to an international sporting event harbouring infection, as opposed to developing infection due to competition-related immune dysfunction[6].

This acknowledged, it is established that participation in frequent, prolonged and intense exercise is associated with both short and long term perturbations in immune function. It is a long-standing notion that there exists a 'J-shaped'

relationship between exercise workload / loading and susceptibility to URTi, i.e. that both low and very high levels of regular physical activity or loading are associated with a heightened risk of URTi. This notion has been challenged by the finding that 'super-elite' athletes appear to have a lower prevalence of URTi and thus it has been proposed that the relationship between infection susceptibility and URTi may be better described by a S-type configuration. Whether this observation reflects, athlete-specific 'protective' genetic factors or relates to illness avoidance behaviour, in this sub-group of athletes, remains unclear[7].

WHAT DO WE KNOW ABOUT POTENTIALLY MODIFIABLE RISK FACTORS FOR URTI?

Several factors have been proposed to be relevant in terms of increasing the risk of URTi in athletes (for comprehensive review see Derman et al[8]). Studies have demonstrated that disturbed sleep, long-haul travel, psychological stress, environmental exposure (e.g. exercising in cold and wet weather) and inadequate nutritional support (i.e. low energy availability) are relevant and potentially modifiable risk factors (for a detailed review, see Walsh[9]). In athlete groups, participation in endurance sport and training at altitude and in the winter appear to be positively associated with risk of URTi. In addition, travelling across multiple time zones appears to be a risk. Sudden fluctuations in training load is also associated with increased URTi susceptibility. This acknowledged, deciphering the most relevant factor(s) in an individual is complex and many studies in this area utilise surrogate measures (e.g. tests of mucosal immune function, such as salivary IgA), to assume heightened URTi risk. The validity of this approach has been challenged by some groups[10].

In some scenarios there will be relevant athlete-specific factors. In this respect, in a cohort of elite British athletes preparing for Olympic competition, it was found that report of problematic laryngeal symptoms (when well), was associated with susceptibility to URTi and that the presence or absence of asthma was less relevant[11].

Overall, therefore, prevention of URTI in athletes should account for athlete-specific factors, but must be grounded in the substantial evidence base on illness transmission and susceptibility that exists in the general population.

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Illustration

WHAT INTERVENTIONS MAY HELP TO PREVENT URTi?

Personal hygiene and social interaction

The SARS-CoV-2 pandemic provided compelling real-world evidence that standard infection control measures significantly reduce the incidence of respiratory infections more broadly. The majority of respiratory viruses are transmitted via respiratory droplets and aerosols generated during loud conversation, breathing, coughing and sneezing, with additional transmission occurring via direct contact with contaminated surfaces followed by self-inoculation of the nasal or ocular mucosa. Established preventive measures including regular handwashing, use of alcohol-based hand sanitiser, and social distancing, particularly from individuals displaying symptoms of active infection.

Precautions during travel

Travel is a key risk factor for athletes. It usually takes place during a period of increased training or psychological load, both of which are known to increase the risk of acquiring an URTi, and there is an increased risk of pathogen exposure. It is important to educate athletes on strict personal hygiene measures, appropriate use of masks and social distancing where possible. It is important to avoid further immunosuppression during travel, so optimise sleep in the days leading up to travel and reduce training volume and intensity, where possible, on the day of travel.

Appropriate use of face coverings represents an additional protective measure, particularly in high-risk environments. We recommend that our athletes travel with a well-fitted FFP2 or N95 respirator mask and wear this during air travel, if seated in close proximity to a fellow passenger exhibiting symptoms of respiratory infection.

Some SEM clinicians will consider recommending prophylactic use of zinc lozenges and probiotics, and ensure the athlete maintains hydration and a high-quality diet on or immediately before the day of travel. For athletes that have been in close contact with an infected individual, it may be appropriate to initiate use of a First defence or Coldzyme spray. Some athletes will wish to ingest green tea, for potential protective purposes.

Vaccination

Although RTI can occur throughout the year, the frequency of certain infections follows a seasonal pattern, consistent with that observed in the general population, with peak incidence during winter and spring. Influenza contributes significantly to this seasonal variation, and annual influenza vaccination is therefore an essential component of any prevention programme. Antigenic changes necessitate yearly reformulation of the influenza vaccine, and annual re-vaccination is recommended.

Vaccine hesitancy is described in athletic populations, often driven by concern regarding potential adverse effects and risk of a vaccine causing an infection. Local reactions, including injection site pain, and mild systemic effects such as low-grade fever may occur, and some clinicians advise timing vaccination to precede a rest day to minimise disruption to training. We recommend pre-empting these concerns with a discussion based on the published evidence re: vaccines; acting to reassure and address any athlete concerns.

Additional vaccines should be considered in accordance with local, regional and national guidelines; these include vaccination against SARS-CoV-2. In athletes with recurrent respiratory infections, serum pneumococcal antibody titres should be measured, and vaccination offered where levels are subthreshold.

Beyond pathogen-specific vaccines, completion of a full primary vaccination schedule is important. Athletes should be asked to provide immunisation records at the point of entry into an elite programme, and any identified gaps in coverage addressed promptly.

Nutrition support and supplements

Optimal nutritional status is fundamental to immune health, and athletes identified as susceptible to URTi warrant thorough nutritional assessment. This should encompass an assessment of total caloric intake relative to training demands, meal timing in relation to training sessions to optimise recovery, and both macro- and micronutrient sufficiency. Where deficiencies are identified, an individualised nutrition plan should be implemented. Clinicians working in sport and exercise medicine will be aware of how to screen and diagnose, Relative Energy Deficiency in Sport (REDs) syndrome, which can manifest as increased susceptibility to infection, among its broader clinical sequelae.

> ***Risk factors for URTi in athletes are frequently attributed to complex exercise-induced immune pathology, however common risk factors affecting the general population are just as important, yet often overlooked.***

Vitamin D deficiency is an established risk factor for URTI in athletes, and screening is particularly recommended in endurance athletes and those competing during winter months, when ultraviolet B exposure is insufficient to maintain adequate circulating 25-hydroxyvitamin D concentrations. Deficiency is generally defined as a serum 25(OH)D concentration below 30 nmol/L, with insufficiency defined as below 50 nmol/L, though some authorities advocate higher thresholds for optimal immune function. We recommend screening in early autumn to allow correction before the higher-risk winter period, with repeat testing in spring given the cumulative effect of reduced sunlight exposure on plasma levels.

During periods of increased infection risk, such as intensified training blocks, competition phases, or international travel, consideration should be given to targeted supplementation with probiotics, vitamin C, and omega-3 fatty acids, for each of which there is supporting evidence in athletic populations. In some, we have found value from 'treating to target', i.e. testing red cell Omega levels (e.g. with omegaquant.com), supplementing deficiency and then retesting, to ensure supplementation is effective.

Training load and type of training

Specific training-related factors have been identified as independent contributors to URTi susceptibility. Rapid increases in training load, training monotony, insufficient tapering prior to competition, and the physiological and logistical stressors associated with international travel have all been associated with increased URTi incidence. SEM clinicians working in elite sport will be familiar with these risk factors and consideration should be given to proactive periodic monitoring of mental wellbeing using, for example, the IOC SMHAT-1. Clinicians should also be alert to the signs of overreaching and non-functional overreaching, both of which are associated with immune perturbation and heightened infection risk. Comprehensive and prospective monitoring of internal and external training load is therefore an important component of any illness prevention strategy, enabling early identification of athletes at elevated risk and timely modification of training programmes where indicated.

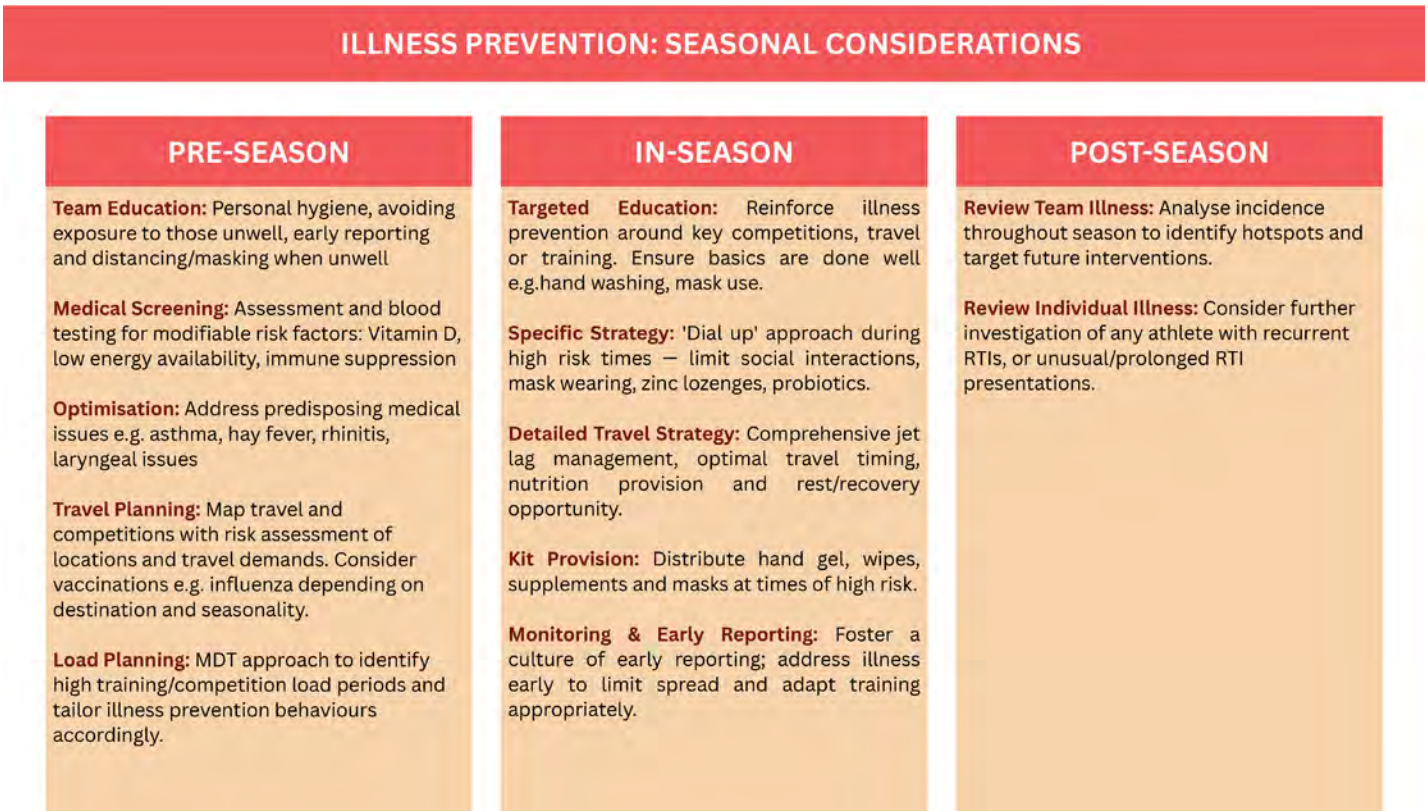

Figure 1: Season-based approach to illness prevention in an athletic team.

HOW MIGHT A URTi PREVENTION STRATEGY WORK IN A SPORTS TEAM?

An effective RTI prevention strategy in athletes should address both intrinsic host factors and extrinsic environmental exposures, with sufficient flexibility to accommodate the changing physiological and logistical demands of a competitive season. Any strategy must be pragmatic and deliverable within the operational and financial constraints of the programme. Whilst comprehensive immune function profiling and pre-travel health screening represent aspirational components of an athlete health programme, these may not be feasible for all squads. Prevention strategies should therefore be risk-stratified, prioritising interventions with the strongest evidence base, lowest resource requirement, and greatest potential impact on reducing infection incidence and training time lost. We recommend they are also practical and easy to explain (see Top 10 recommendations).

We present a practical framework that clinicians may adopt in full or in part, according to the needs and resources of their programme. Our approach is structured around the key phases of a typical competitive season (Figure 1).

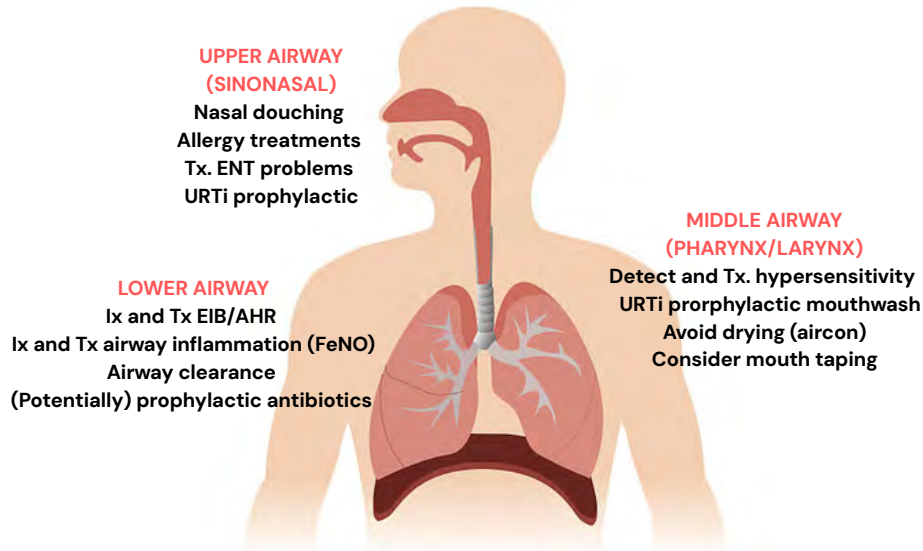

Figure 2: Total airway approach to considering risk factors for URTi and their prevention. AHR=Airway hyper-responsiveness; EIB=exercise induced bronchoconstriction ENT=Ear, nose and throat; URTi=Upper respiratory tract infection.

PRE-SEASON CONSIDERATIONS

- **Team education:** on illness prevention measures: personal hygiene, avoiding exposure to those unwell, early reporting and distancing / masking when unwell.
- **Medical screening:** medical assessment and blood testing for modifiable risk factors: Vitamin D, low energy availability, immune suppression.
- **Detection and management of medical issues:** identify and treat predisposing medical issues for example asthma, hayfever, rhinitis, laryngeal issues. Consider this from the perspective of the 'total airway' (Figure 2).

TOP 10 TIPS TO PREVENT URTI IN ATHLETES

Evidence-based recommendations for team physicians and sports medicine practitioners

1. **Avoid exposure**
   Minimise close contact with symptomatic individuals, particularly during autumn and winter months.
2. **Do the basics well**
   Wash hands regularly, use alcohol-based sanitiser, and avoid touching the eyes, nose, and mouth.
3. **Mask up**
   Carry a well-fitted FFP2/N95 respirator and wear it during air travel when seated near symptomatic passengers.
4. **Vaccinate**
   Ensure annual influenza vaccination and a complete primary vaccination schedule, with additional vaccines considered based on travel and national guidelines.
5. **Manage training load**
   Avoid rapid load increases, replace overly long sessions with spike sessions, and plan a recovery week every two to three weeks.
6. **Act to minimise stress**
   Monitor and address physical, competition, travel, and psychosocial stressors, each of which independently impairs immune function.
7. **Prioritise recovery and sleep**
   Aim for a minimum of seven hours per night, particularly around intense training, competition, and travel. Avoid excessive exposure to very dry (air-conditioned) sleep environments.
8. **Optimise nutrition and hydration**
   Maintain a well-balanced diet, avoid low energy availability, and screen for REDs and vitamin D deficiency. Ensure hydration status is well maintained.
9. **Supplement strategically**
   Consider probiotics, vitamin C, and omega-3 fatty acids during high-risk periods such as intensified training blocks and international travel.
10. **Screen and review — always keep optimising**
    Conduct pre-season medical screening, encourage early illness reporting, optimise predisposing illness, and review team illness patterns at season end.

- **Travel planning:** map travel and competitions throughout season with risk assessment of locations and travel demands. Comprehensive planning should give due consideration for specific allergy mapping (i.e. based upon a race plan) and detailed jet lag management strategy (e.g. with use of a timeshifter app). Consider specific vaccinations, e.g. infectious diseases depending on location and seasonality of travel.
- **Load planning:** MDT approach with athlete and coaches to identify points of high training / competition load throughout season and appropriately tailor dial up / dial down of illness prevention behaviours. Consideration of stress and recovery strategies.

IN-SEASON CONSIDERATIONS

- **Targeted education:** reinforcement of specific illness prevention education around key competitions, travel or training. Making sure the basics are 'done well', e.g. hand washing and use of masks etc.
- **Specific strategy:** 'dial up approach' during high-risk times; consider limitation of social interactions to reduce exposure, mask wearing, use of zinc lozenges / probiotics proactively. Additional use of medical strategies such as sinus rinsing, coldzyme and or first defence may also be used as adjuncts.
- **Detailed travel strategy:** including comprehensive jet lag management for example using planner app, and optimal travel timing, nutrition provision and opportunity for rest and recovery. Consider use of wearables to track sleep on arrival and optimise sleep 'banking' prior to travel.
- **Kit provision:** consider distribution of hand gel, wipes, supplements and masks at times of high risk
- **Monitoring and early reporting:** encourage a culture of early reporting and address illness early to limit spread and appropriately adapt training,

POST SEASON CONSIDERATIONS

- **Review team illness:** assess incidence throughout season to identify hot spots and target future intervention.
- **Review individual illness:** incidence and consider further investigation of any athlete with recurrent episodes of RTI through season, or any athlete with unusual or prolonged RTI presentation.

CONCLUSIONS

In summary, URTi poses a meaningful threat to athlete health and performance. In this article we have discussed some of the key risk factors and present a season-long approach to prevention of URTi. While prospective data identifying optimal preventive interventions remains limited currently, we recommend clinicians adopt a systematic, sport-specific approach at the start of each season to develop a pragmatic URTi prevention programme tailored to their athlete cohort.

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