THE HAE OUTLIER PROCESS

A practical guide for teams

WORLD RUGBY

Instrumented mouthguards (IMGs) are already used in the Head Injury Assessment (HIA) protocol to flag significant head acceleration events (HAEs) during matches. These significant HAEs, which represent approximately the top 99.9th percentile in the game (1:1000 events), identify players were are removed for assessment. This use focuses on a single very high magnitude event.

The outlier process applies the same technology over a longer time frame, looking at the HAEs a player accumulates across three weeks. This represents a cumulative, rather than single-event, view of exposure, and aims to address the question of whether a player who experiences an atypically high number of moderate to large head acceleration events, which can come only from head impacts, should be identified and managed differently from his/her peers? The concussion working group has added the identification of outliers to the HIA protocol.

Importantly, being flagged as an outlier does not enter a player into the HIA protocol or any clinical pathway, and it is not a diagnosis of any clinical condition. Instead, what being identified as an outlier, triggers is a load-management opportunity for the player and the high-performance staff supporting that player.

You already have access to your own players' IMG data, but HAE monitoring is still relatively new and its practical use is less familiar than the use of other tools like GPS. World Rugby is therefore introducing an educational process that analyses and packages your team's HAE data into a weekly report. The purpose of this report is to support player welfare initiatives by initiating a conversation about head impact load that will ultimately enhance the understanding of load and improve player load-management interventions.

The report has two primary aims: 1) to flag players who have accumulated a statistically high number of HAEs across the previous three-week period; and 2) to provide insight into what might explain that high HAE count so that it may be prevented in future.

No specific action is mandated for a flagged player at this stage, while the process remains an educational one. The flag provides a starting point for an informed discussion between medical, coaching and conditioning staff and the player, with the response determined locally and without obligation to any other stakeholder.

A secondary aim of the weekly outlier report is to identify players who are "at risk" of becoming outliers if their HAE exposure continues to rise. The purpose of this aspect of the reporting is to help teams identify patterns and understand what contributes to HAE exposure, so that they can use the information provided by selected players in their HAE load-management of players, which will benefit the entire player group.

HOW DOES THIS WORK OPERATIONALLY?

Each week your team will receive a report that presents your players' moderate HAE exposure or count over the previous three weeks. A moderate HAE magnitude has been chosen so that

head accelerations from inertial movements, like sudden accelerations or decelerations, are not included, but rather only HAEs that are almost certainly the result of head impacts, and which correspond to the top 10% of HAEs by magnitude are included when outliers are identified.

The report will contain three sections:

OUTLIER PLAYERS. Players with a high cumulative count of moderate HAEs above 25g over the previous 3-weeks. This will be 36 or more moderate HAEs in the men's game, or 24 or more in the women's game. Each outlier player will have an individual profile showing how their count accumulated across the three match weeks. The outlier thresholds were derived from the distribution of recorded HAE counts using a statistical cut-off two standard deviations above the mean and thus correspond to statistical outliers expected to be in approximately the top 3% of all players. Expert consensus supported a three-week window.

AT-RISK PLAYERS. These are players whose moderate HAE counts are below, but approaching, the outlier level. They are in the highest 10% of players, but do not currently exceed the above-described statistical outlier thresholds. The purpose of highlighting these players in the report is to support earlier consideration of their HAE exposure, since their HAE count will be explored as a function of risk and exposure to risk events. It is important to note that "at-risk" means at risk of becoming an outlier, and is not a prediction of injury.

WHOLE SQUAD DATA. Information on all monitored players, including those who are not outliers or at-risk, showing HAE counts alongside playing time and contact involvement. This will provide context for understanding differences between players within a team.

First priority: review the outliers. At a minimum, teams need to consider each outlier player, understand what is driving their HAE count and discuss ways to reduce their HAE count so that they move out of outlier status. The report supports that discussion; it does not prescribe a specific intervention.

Second priority: consider the at-risk players. Review what is contributing to their HAE counts, with the purpose of identifying ways to manage their exposure to prevent them from becoming outliers in future. The whole-squad information can be used for context and to inform both discussions.

WHY WOULD A PLAYER BE AN OUTLIER?

Two things drive outlier status:

1 VOLUME

Some players experience more "head impacts" because **they play more** – more minutes means more contacts and likelihood of head impact events

2 RISK

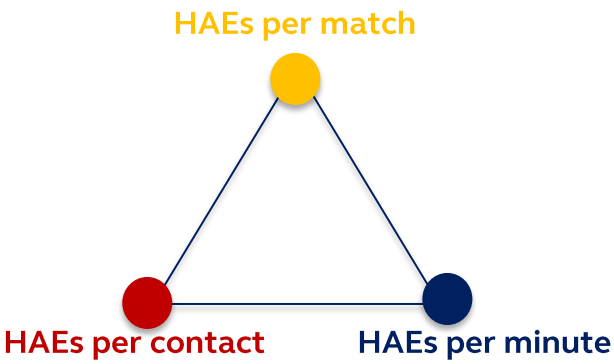
Some players experience more "head impacts" because when they're play, **they're more at risk**

A

Because they do **more of the things that cause impacts**

B

Because they are **more likely to have head impacts** when they do those things

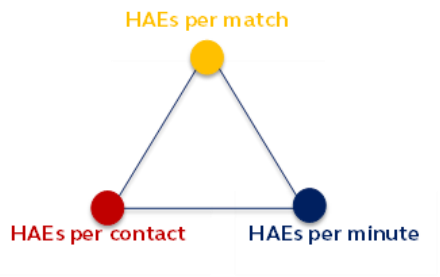


The interaction between volume and rate of HAEs means that any player's HAE count is a function of how much they play, what they do when they play, and their risks of an HAE from those actions and activities. The three resultant rates point to the "aetiology" of an HAE count

A player's cumulative HAE count determines their outlier status. The other measurements, specifically rates of HAEs per match, per minute and per contact, help explain that total by asking progressively more specific questions:

MEASUREMENT	QUESTION IT HELPS ANSWER
HAEs per match	How many HAEs does the player record per appearance? Read this alongside minutes: a short appearance and a full match are not equivalent.
HAEs per minute	How quickly does the player accumulate HAEs while playing? This accounts for playing time, but does not explain whether they had more contacts or more HAEs per contact.
HAEs per contact	How many HAEs are recorded relative to contact involvement? The HAE count may be expressed per 1000 contacts, for example. Note that this expression of HAEs per 1,000 contacts is simply scaled for comparison, and does not mean the player had 1,000 contacts.

WHY THE SAME COUNT CAN MEAN DIFFERENT THINGS



Three factors interact to determine the total HAE count experienced by a player: how much rugby a player plays (matches and minutes), how many contacts they have while playing (their activity profile), and how many HAEs occur relative to those contacts (their HAE risk profile). More minutes can produce more HAEs simply through more opportunities for contact. But two players with the same minutes can have different counts, and two players with the same number of contacts can also have different HAE outcomes. Appreciating all three will create a picture to help understand whether a player's high HAE count is a result of exposure to volume, or risk when exposed to contact.

TURNING THE REPORT INTO A TEAM DISCUSSION

Data are contextualised throughout the report to help guide understanding, thought processes and discussions. For a flagged outlier player, it is recommended that three questions be considered:

1. Did the HAE count come from one match or did it build over the period?
2. Does the high HAE count mainly reflect playing volume, contact involvement or a high HAE rate during contact?
3. What additional information would help explain the statistically high HAE count? Use the match context, the player's role, the team's existing monitoring and relevant video where available.

High volume may prompt a load-management discussion. A high rate during contact may invite technique and video review to seek ways to reduce the likelihood of a head impact and head acceleration when contact is experienced. Some players may warrant both volume and technical interventions. These are avenues to investigate, rather than automatic prescription, and should ideally involve an integrated approach with input from various stakeholders of the HP team.

No reduction in playing time, selection restriction or other specific intervention is mandated when a player is flagged. Flagged outlier players should, however, be informed. Clinical judgement and existing concussion procedures continue to apply independently of this educational process.

WHEN WILL REPORTS START, AND HOW WILL THEY REACH TEAMS?

The process applies from the start of competition seasons beginning on or after September 2026. Teams should expect their first report in week three and weekly reports thereafter.

Initially, each team will receive a PDF report displaying only their own players' data, with all other players in their competition visible in the report, but anonymized. In time, this may evolve to be a dynamic, interactive dashboard to help further support engagement. In all reports, each team will be able to identify its players, whereas the identify of other players will be hidden, though the spread of players from the competition will be visible for comparison.

World Rugby will agree the communication route with each union or competition. Reports may go to a union or competition contact for distribution to teams, or directly to agreed team contacts. Medical and coaching staff are central to explaining the findings to players.

WHAT IF A PLAYER DID NOT WEAR THEIR IMG IN PART OR A FULL MATCH?

World Rugby wishes to encourage ever player to wear the IMG, and team doctors to support the widespread adoption and compliance of players with the IMG, given the value of the data it provides. However, it is recognized that players will, on occasion, not provided data, for a range of reasons that includes medical exemptions.

Where this happens, a gap in recording is not treated as zero HAE exposure. Missing data will be imputed, using statistical models that have been developed and applied over the last three seasons of rugby. These imputed amounts are essentially estimates, based on models that account for playing position, contact exposure and playing time, of how many HAEs a player might have experienced had they worn an IMG. Wearing the IMG throughout each match helps keep reviews based on the player's own measured data rather than estimates based on the positional averages.

ARE TRAINING DATA INCLUDED?

At present, a player's Outlier status is determined solely from HAEs recorded during match exposure and all HAE counts presented in the report relate to match events only.

However, the purpose of the weekly Outlier report is to identify players who have accumulated statistically high match HAE counts over the preceding three weeks. Training HAE exposure and rates therefore provide important additional context when interpreting a player's match HAE profile. In particular, clubs may wish to give additional consideration to the training contact exposure of players identified as Outliers, or as "at risk" of becoming Outliers.

The management of contact training exposure and associated risk is the responsibility of each club and thus clubs should consider using their training HAE data, alongside the match-based information in this report, to inform internal discussions and decisions relating to the management of players with high recent HAE exposure.

Where World Rugby has access to consistently collected training HAE data within a competition, a fourth section will be included in the weekly Outlier report. This section will display team-level training HAE counts to provide further context on training exposure. In these reports, training HAE data will not contribute to a player's Outlier or "at risk" status,. It is included solely for educational and contextual purposes, to support conversations within clubs about training exposure and to help inform the management of players identified as Outliers or "at risk".

WILL CLUB AND NATIONAL-TEAM STAFF RECEIVE EACH OTHER'S REPORTS?

Outlier reports are generated using each player's preceding three weeks of match HAE exposure. This rolling three-week period applies irrespective of whether the player's matches were played while representing their club or national team.

Accordingly, the report received by the team responsible for the player at that time will reflect the player's match HAE exposure across the full preceding three-week period.

This approach is intended to maintain continuity of the player's recent exposure profile as they move between club and national-team environments. It does not provide either environment with access to the other's dashboard, nor does it constitute ongoing access to data outside the rolling three-week reporting period.

Any wider sharing of player data or reports between club and national-team environments remains subject to the applicable club–country agreement and associated local arrangements of sharing data to support the move of players between their club and country duties.

HOW WILL SVNS BE MANAGED?

The three-week period over which HAE outliers are identified does not fit the SVNS tournament schedule, where a maximum of two weeks of matches are played. As such, there is not current agreement of an outlier, in a statistical sense, as applied to SVNS. The intention, However, is to produce tournament by tournament reports to the teams, which note the players with higher than typical HAE exposure without labelling them directly as outliers under the same statistical standard as XVs. The specific reporting criteria are still to be determined and will be communicated in due course.

WEBINAR ON THE OUTLIER PROCESS?

https://worldrugby.zoom.us/rec/share/3XNbMtPYIPIADu7Cl_Q6GBLda6IQsQd8Ebetre2v-kIOBoEBz9B8VRbx80FIqeHI.dyExfS1eFuLhn6eD

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Time	Section
01:23	Welcome and speaker introductions
02:04	**Éanna:** Why the outlier process is being introduced
06:35	How exposure varies between positions and individual players
09:17	Why the focus is individualised exposure management
10:36	**Ross:** How the statistical explanation begins
12:12	Playing time, position and variation in HAE counts
14:38	Contact involvement and HAEs per hour or per contact
23:50	The rolling three-week outlier threshold and a two-player example
25:19	Why a player becomes an outlier: volume versus HAE rate per contact
27:50	From flagging outliers to understanding causes and identifying at-risk players
31:23	**Lindsay:** Purpose of the weekly report and its educational role
32:16	Weekly delivery, team-only data, initial PDF and planned dashboard
37:01	Individual outlier profile: how the three-week count accumulated
38:53	At-risk players and how to read the quadrant chart
40:48	Whole-squad view and comparison by minutes and contact involvement