FIVB Heat Stress Monitoring Protocol – FIVB beach volleyball events

Background

During the final the 2007 Grand Slam event in Berlin, the team from Germany was forced to forfeit the match when one of the members of the team could not continue playing due to heat exhaustion. Although the athlete subsequently recovered, the outcome could have been much worse. There are numerous examples of athletes in other sports dying from heat-related illness.

Based on a concern regarding the risk of heat illness among the athletes competing in FIVB beach volleyball events, the FIVB Medical Commission has considered whether to adopt any guidelines for the prevention of heat-related illnesses since 2003. Ultimately, the FIVB Medical Commission has decided not to recommend any formal policy. However, given the substantial risk for heat illness to the athletes who compete on the tour, the Medical Commission has decided to establish a surveillance program to monitor heat stress and record any cases of heat-related medical forfeits in FIVB beach volleyball events.

While this document will not review the pathophysiology of heat illness, suffice it to say that the risks are indeed very real in conditions of high heat and humidity. The Wet Bulb Globe Temperature (WBGT) is generally considered to be the best measure of heat stress. The WBGT is a composite temperature used to estimate the effect of temperature, humidity, wind speed (wind chill) and solar radiation on humans. It is used by industry and the military to determine appropriate exposure levels to high temperatures. It is derived from a simple formula which includes the effects of air temperature (TA), black globe temperature (TG, to measure solar radiation) and humidity. Instruments to measure WBGT also account for any wind cooling effect.

Based on WBGT measurements, several systems have been developed to estimate the risk of developing heat illness, e.g. by the American College of Sports Medicine (ACSM) and the United States Navy. Both use the “warning flag” concept of stratifying risk, although the US Navy system is much less conservative than the ACSM system. One possible explanation for this may be that the Navy is confident of its ability to control those risk factors that are within its ability to influence – most notably acclimatization, and the general fitness level of its soldiers. The ACSM, on the other hand, is preparing a guideline for a broad range of athletic participants who may be in various states of conditioning and acclimatization, and thus must be more conservative.

US Navy Heat Stress Warning Systems (based upon the WBGT)

WBGT Index (degrees C)	US Navy Flag Color	US Navy Recommendations
< 27	White	Take caution when participating in extremely intense activity
27 < 29	Green	Discretion advised for unacclimatized personnel
29 < 31	Yellow	Limit strenuous activity for unacclimatized personnel
31 ≤ 32	Red	Curtail activity for all but the most acclimatized
> 32	Black	Suspend activity for all personnel

In an effort to better understand the magnitude of that potential danger, the FIVB Medical Commission analyzed the maximum temperature and associated humidity conditions that occurred during each of the 72 FIVB World Tour events contested between 2004-2007 based on retrospectively weather data for each of the cities on the tour (or a nearby city) during the dates of the given competition. Based on these analyses, it became apparent that – if the US Navy guidelines are applied – potentially dangerous weather conditions were in place during an alarmingly high number of tournaments over this 4-year period. Indeed, 9 (13%) of the World Tour events would have had a US Navy "black flag" WBGT condition at some point during the competition. A weakness of this analysis is that it relies on temperatures recorded from an official meteorological site (usually an airport) that clearly do not reflect the courtside conditions to which the athletes were subjected at the venue. It is in fact quite likely that the courtside WBGT would have exceeded those values calculated and reported above – possibly increasing the number of "black flag" conditions.

Unfortunately, we have no data available on the incidence of heat-related illness during the same period, as we have no systematic surveillance of such cases. However, anecdotal evidence based on interviews with players, FIVB officials and FIVB Medical Commission members suggests that there have been very few cases of medical forfeits due to heat exhaustion on the World Tour, even fewer where medical intervention has been necessary and none with serious health consequences to our player.

Therefore, there seems to be a discrepancy between the available heat stress guidelines and the actual risk of heat-related illness among the professional players competing in FIVB beach volleyball events. If US Navy guidelines were used to guide policy, as many as 10-20% of our events would have had to be suspended or cancelled. Yet, no serious health consequences to the players have been recorded. Reasons for this could be that our players are very well acclimatized to the heat, that the players are experienced and well educated on safe hydration practices, that beach volleyball (in contrast to e.g. marathon running) is an intermittent activity with sufficient breaks during the game to allow players to rehydrate. In other words, there are currently no WBGT guidelines available to assess risk properly in FIVB beach volleyball events. And perhaps for the same reason there are surprisingly few international sports governing bodies that have published guidelines for the prevention of heat illness during sanctioned competitions. There is simply insufficient data on elite, acclimatized players on which to base such guidelines. The only guidelines we currently have for beach volleyball, is the official rules, which

stipulate that “The weather must not present any danger of injury to the players” (article 1.5).

Based on this, the FIVB has decided to establish a surveillance program to monitor heat stress and record any cases of heat-related medical forfeits in FIVB beach volleyball events.

Procedures

The FIVB Heat Stress Monitoring Protocol consists of three elements; 1) WBGT measurements on center court during all FIVB beach volleyball events, 2) Continuous data collection covering all events, and 3) systematic recording of any heat-related medical forfeits. The data collection and reporting is the responsibility of the FIVB Referee Delegate (and FIVB Medical Delegate, if present).

WBGT Measurements

Temperature measurements are to be taken on center court 5 min before the start of each game in front of the scorers table, apx. 1.5 m above the sand level. If the scorers table is shaded, the measurement must be made closer to the court or even on court in the sunny area. No measurements are necessary from the outside courts.

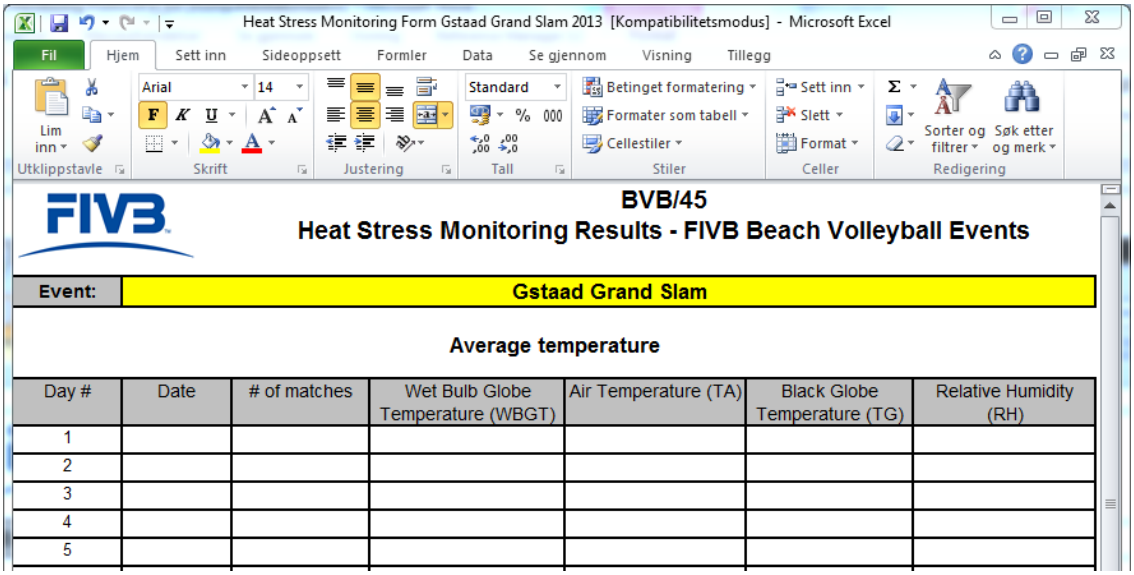
The measurements are to be taken by a reserve referee (or the referee of the match before). The data collection procedures must be instructed at the referee's clinic before each tournament.

The following data should be recorded on the Heat Stress Monitoring Form: Wet Bulb Globe Temperature (WBGT), Air Temperature (TA), Black Globe Temperature (TG) and Relative Humidity (RH).

The data are recorded using a Heat Stress WBGT Meter (Model HT30, Extech Technology). Please see the User’s Manual for detailed instructions on how to operate the meter. But please note the following important points: First, that the protective sliding cover must be open, to allow air (wind) to stream through the meter. Second, that the meter should always be set for the outside (OUT) mode, regardless if there is direct sun exposure or not. The alarm settings have been disabled by setting it to the maximum limit.

WBGT Data Reporting

An Excel file has been created to enter the data collected. In preparation for the event, the name of the event is entered on the first page (Main results) of the Excel file, e.g. 1 to 1 energy Grand Slam – Gstaad (yellow area, see example below).



Heat Stress Monitoring Form Gstaad Grand Slam 2013 [Kompatibilitetsmodus] - Microsoft Excel

BVB/45

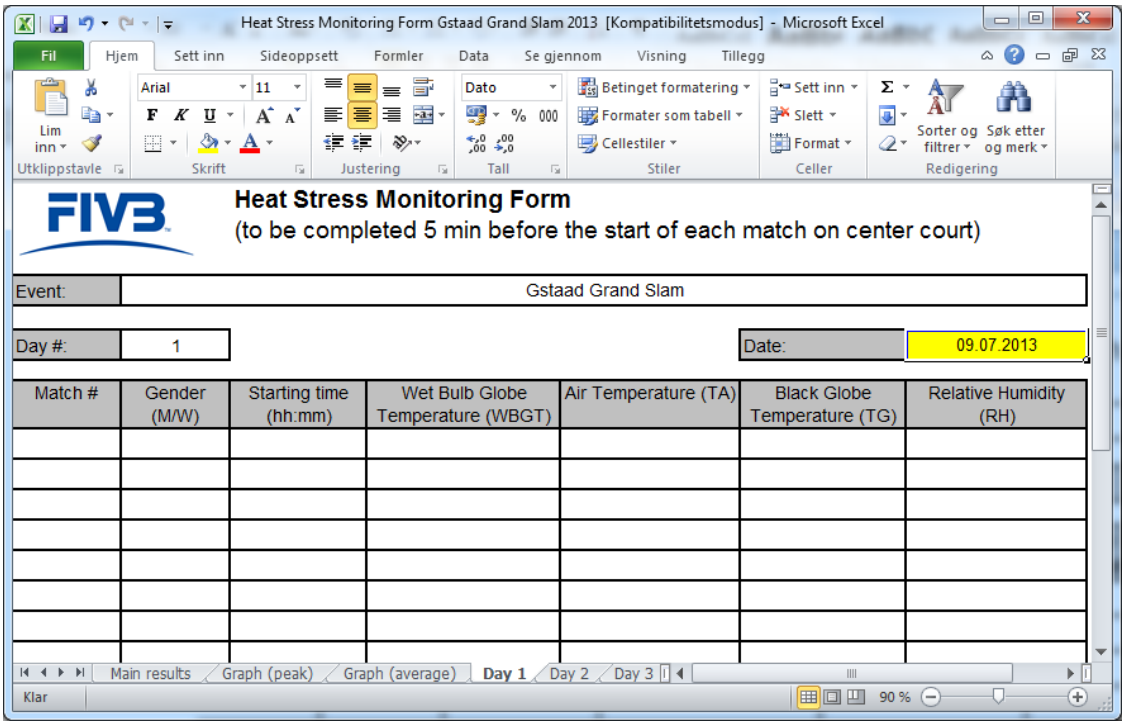
Heat Stress Monitoring Results - FIVB Beach Volleyball Events

Event:	Gstaad Grand Slam

Average temperature

Day #	Date	# of matches	Wet Bulb Globe Temperature (WBGT)	Air Temperature (TA)	Black Globe Temperature (TG)	Relative Humidity (RH)
1						
2						
3						
4						
5						

The dates are entered on each of the following pages (Day 1, Day 2, Day 3, etc.), including the qualification days (yellow area, see example below).



Heat Stress Monitoring Form Gstaad Grand Slam 2013 [Kompatibilitetsmodus] - Microsoft Excel

Heat Stress Monitoring Form

(to be completed 5 min before the start of each match on center court)

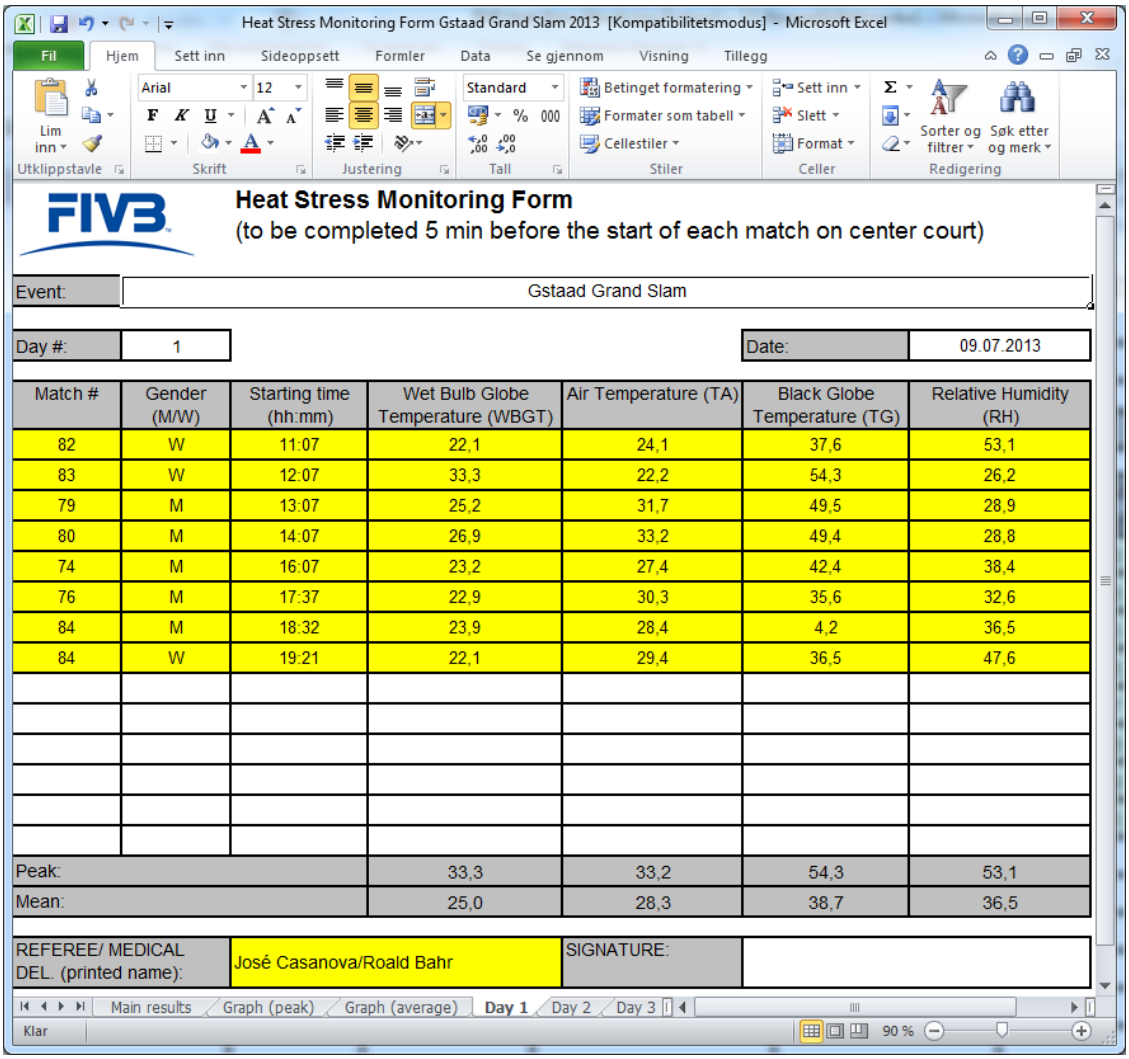
Event:	Gstaad Grand Slam		
Day #:	1	Date:	09.07.2013

Match #	Gender (M/W)	Starting time (hh:mm)	Wet Bulb Globe Temperature (WBGT)	Air Temperature (TA)	Black Globe Temperature (TG)	Relative Humidity (RH)

Main results | Graph (peak) | Graph (average) | Day 1 | Day 2 | Day 3

Printouts are made of each of daily Heat Stress Monitoring Form and these paper forms are used on center court to enter the data collected.

The data from the paper forms are entered into the Excel file on the relevant pages (Day 1, Day 2, Day 3, etc.) at the end of each day (yellow area, see below). Daily averages and peak values will be calculated automatically.



Heat Stress Monitoring Form Gstaad Grand Slam 2013 [Kompatibilitetsmodus] - Microsoft Excel

Heat Stress Monitoring Form
(to be completed 5 min before the start of each match on center court)

Event:	Gstaad Grand Slam					
Day #:	1				Date:	09.07.2013

Match #	Gender (M/W)	Starting time (hh:mm)	Wet Bulb Globe Temperature (WBGT)	Air Temperature (TA)	Black Globe Temperature (TG)	Relative Humidity (RH)
82	W	11:07	22,1	24,1	37,6	53,1
83	W	12:07	33,3	22,2	54,3	26,2
79	M	13:07	25,2	31,7	49,5	28,9
80	M	14:07	26,9	33,2	49,4	28,8
74	M	16:07	23,2	27,4	42,4	38,4
76	M	17:37	22,9	30,3	35,6	32,6
84	M	18:32	23,9	28,4	4,2	36,5
84	W	19:21	22,1	29,4	36,5	47,6
Peak:			33,3	33,2	54,3	53,1
Mean:			25,0	28,3	38,7	36,5

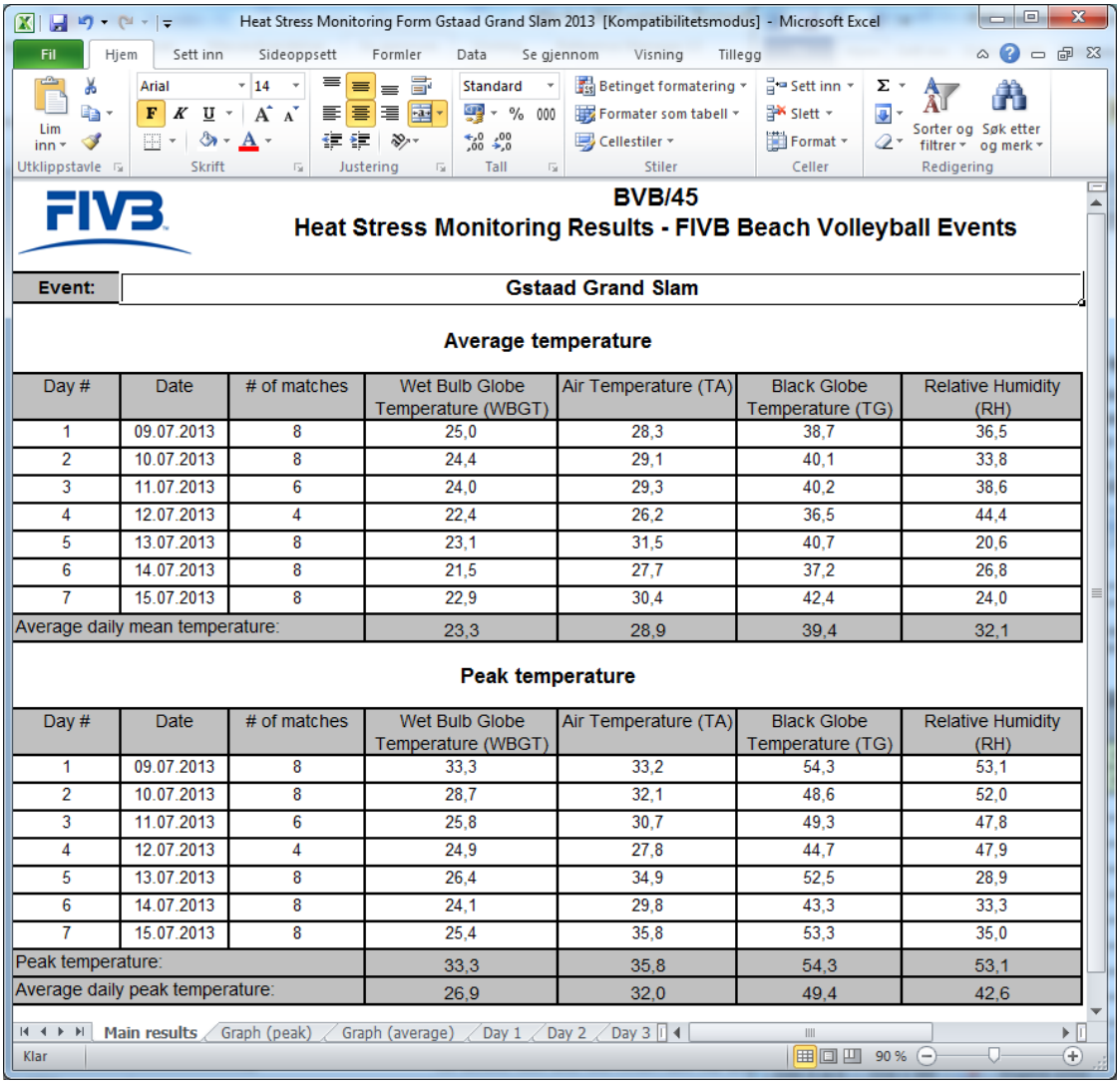
REFEREE/ MEDICAL DEL. (printed name):	José Casanova/Roald Bahr	SIGNATURE:	

Main results | Graph (peak) | Graph (average) | Day 1 | Day 2 | Day 3

Klar

Printouts are made from the Excel file each day to be checked and signed by the referee delegate (or medical delegate, if present) against the original paper record.

The Excel file has been designed to calculate the average weather data for the tournament (see example below).



Heat Stress Monitoring Form Gstaad Grand Slam 2013 [Kompatibilitetsmodus] - Microsoft Excel

BVB/45

Heat Stress Monitoring Results - FIVB Beach Volleyball Events

Event:	Gstaad Grand Slam

Average temperature

Day #	Date	# of matches	Wet Bulb Globe Temperature (WBGT)	Air Temperature (TA)	Black Globe Temperature (TG)	Relative Humidity (RH)
1	09.07.2013	8	25,0	28,3	38,7	36,5
2	10.07.2013	8	24,4	29,1	40,1	33,8
3	11.07.2013	6	24,0	29,3	40,2	38,6
4	12.07.2013	4	22,4	26,2	36,5	44,4
5	13.07.2013	8	23,1	31,5	40,7	20,6
6	14.07.2013	8	21,5	27,7	37,2	26,8
7	15.07.2013	8	22,9	30,4	42,4	24,0
Average daily mean temperature:			23,3	28,9	39,4	32,1

Peak temperature

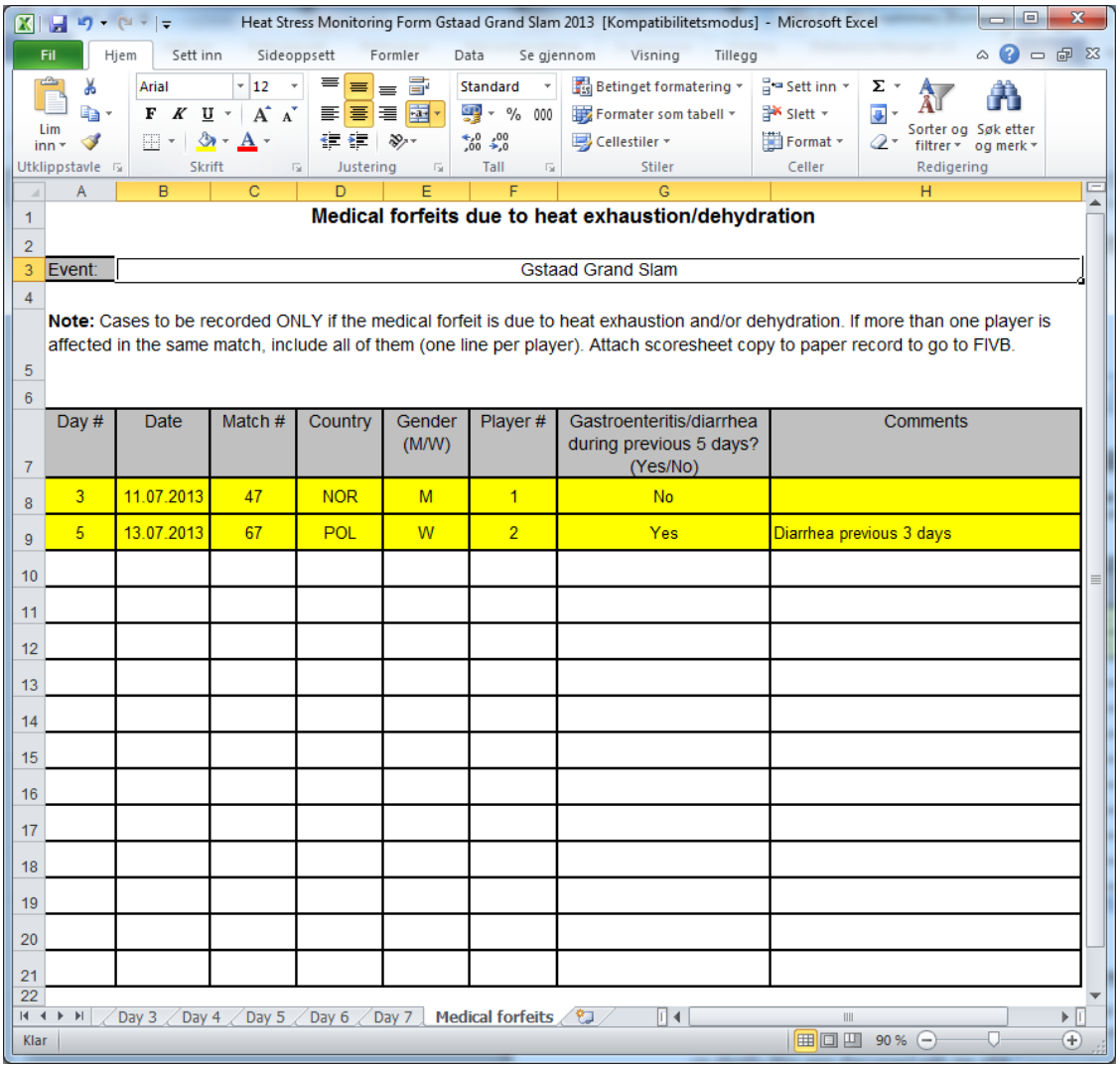
Day #	Date	# of matches	Wet Bulb Globe Temperature (WBGT)	Air Temperature (TA)	Black Globe Temperature (TG)	Relative Humidity (RH)
1	09.07.2013	8	33,3	33,2	54,3	53,1
2	10.07.2013	8	28,7	32,1	48,6	52,0
3	11.07.2013	6	25,8	30,7	49,3	47,8
4	12.07.2013	4	24,9	27,8	44,7	47,9
5	13.07.2013	8	26,4	34,9	52,5	28,9
6	14.07.2013	8	24,1	29,8	43,3	33,3
7	15.07.2013	8	25,4	35,8	53,3	35,0
Peak temperature:			33,3	35,8	54,3	53,1
Average daily peak temperature:			26,9	32,0	49,4	42,6

Main results | Graph (peak) | Graph (average) | Day 1 | Day 2 | Day 3

Klar

Recording of heat-related medical forfeits

In any case of a medical forfeit, the injured player is asked by the referee if this is due to heat exhaustion and/or dehydration. If this is the case, the player is also asked, if he/she has suffered from diarrhea during the past five days? This information reported to the Referee Delegate, who is responsible for including it in the Excel file (see example below, area in yellow).



Heat Stress Monitoring Form Gstaad Grand Slam 2013 [Kompatibilitetsmodus] - Microsoft Excel

Medical forfeits due to heat exhaustion/dehydration

Event:	Gstaad Grand Slam

Note: Cases to be recorded ONLY if the medical forfeit is due to heat exhaustion and/or dehydration. If more than one player is affected in the same match, include all of them (one line per player). Attach scoresheet copy to paper record to go to FIVB.

Day #	Date	Match #	Country	Gender (M/W)	Player #	Gastroenteritis/diarrhea during previous 5 days? (Yes/No)	Comments
3	11.07.2013	47	NOR	M	1	No	
5	13.07.2013	67	POL	W	2	Yes	Diarrhea previous 3 days

Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Medical forfeits

Klar

At the end of the event

The signed printouts are sent to the FIVB along with score sheets and other information after the event (at the responsibility of the Technical Supervisor).

The referee delegate is responsible for sending the Excel file with all data to the Beach Volleyball Referee Commissioner, Mr. José Casanova (jcasanovajcasanova@outlook.pt) and to Dr. Roald Bahr (roald.bahr@nih.no), FIVB Medical Commission member.