SUPPLEMENT to

Phylogenetic distribution of csp1-types in *Aspergillus fumigatus* and their correlates to azole antifungal drug resistance

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Supplementary figure 1: phylogenetic placement of csp1 types and cyp51A alleles, including SRA accession numbers. Rooted phylogenetic tree constructed from whole SNPomes of 211 shotgun genome sequences. Bold: reference genomes. cyp51A isoforms are given after csp1 types as compared to the A1163 reference. “wt” denotes resistant isolates without changes in Cyp51A sequence. Coloured balls are placed at branch intersections used for respective cluster definition.
Supplement

Supplementary Table 1: The 30 CSP types published to date among *Aspergillus fumigatus* isolates using classical repeat unit definitions

| CSP type | Condon | Tandem repeat succession using classical repeat unit definitions | +1 | +2 | +3 | First reported in reference |
|----------|--------|---------------------------------------------------------------|----|----|----|-----------------------------|
| t11      | CCG    | TGG CTC CCG                                                  |    |    |    |                             |
| t18B     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t18A     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t09      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t01      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t10      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t16      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t24      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t05      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t25c     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t26c     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| NF1      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t20      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t22      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t03      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t21      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t23      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t04A     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t04B     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t02      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t25c     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t17      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t14      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t12      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t06A     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t06B     | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t27      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t15      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t08      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t13      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t07      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |
| t19      | GGG    | TGG CTC CCG                                                  |    |    |    |                             |

a CSP type t18A was previously designated only as t18. b there is naming conflict between refs (4), (7), and (6), see text for details.
Supplementary Table 2: detailed *csp1*-type-stratified epidemiologic data

| origin | t01 | t02 | t03 | t04A | t04B | t05 | t06A | t06B | t07 | t08 | t09 | t10 | t11 | t12 | t13 | t14 | t15 | t16 | t17 | t18A | t18B | t19 | t20 | t21 | t22 | t23 | t24 | t25C | t25D | t25G | t26 | t27 | total | reference |
|--------|-----|-----|-----|------|------|-----|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| A) isolates without documented susceptibility testing |     |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| NL     | 78  | 21  | 23  | 36   | 2    | 19  | 1    | 1    | 7   | 4   | 2   | 4   | 4   | 1   | 1   | 6   | 1   | 1   | 1   | 6   | 1   | 1   | 1   | 6   | 1   | 1   | 1   | 6   | 1   | 1   | 1   | 1   | 6   | 1   | 1   | 1   | 6   | 1   | 1   | 209 | (1) |
| OZ     | 26  | 9   | 29  | 35   | 2    | 3   | 1    | 1    | 4   | 2   | 1   | 1   | 2   | 1   | 2   | 5   | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 122 | (5) |
| MX     | 3   | 1   | 2   | 4    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 10  | (8) |
| CN     | 19  | 16  | 33  | 51   | 2    | 5   | 9    | 6    | 3   | 3   | 1   | 3   | 1   | 3   | 1   | 8   | 1   | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 162 | (2) |
| AR     | 2   | 3   | 8   | 12   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 54  | (6) |
| PE     | 2   | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 3   | (6) |
| FR     | 1   | 3   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 4   | (6) |
| sum    | 137 | 57  | 100 | 163  | 2    | 23  | 9    | 18   | 1    | 7   | 5   | 15  | 4   | 4   | 6   | 12  | 1    | 1    | 3   | 2   | 3   | 5   | 1   | 1   | 8   | 1   | 1   | 2   | 593 |     |
| %      | 25.4| 10.6| 18.6| 30.2 | 0.4  | 4.3 | 1.7  | 3.3  | 0.2  | 1.3 | 0.9 | 2.8 | 0.7 | 0.7 | 1.16| 2.2 | 0.2  | 0.2 | 0.6 | 0.4 | 0.6 | 0.9 | 0.2 | 0.2 | 1.5 | 0.2 | 0.2 | 0.4 | 0.4 |

| B) azole susceptible isolates |     |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| NL     | 15  | 4   | 7   | 16   | 2    | 5   | 1    | 1    | 2   | 1   | 1   | 2   | 1   | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 55  | (9) |
| ES     | 24  | 11  | 15  | 32   | 3    | 4   | 4    | 2    | 1   | 3   | 1   | 4   | 1   | 1   | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 111 | (4, 10) |
| CN     | 57  | 11  | 21  | 38   | 1    | 3   | 1    | 7    | 1   | 1   | 1   | 1   | 4   | 4   | 2   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 153 | (7) |
| IR     | 19  | 1   | 13  | 24   | 2    | 1   | 3    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 63  | (11) |
| DE    | 24  | 14  | 43  | 13   | 14   | 3   | 2    | 4    | 1   | 3   | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 122 | this study |
| UK     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 6   | (12) |
| sum    | 82  | 30  | 79  | 88   | 20   | 2   | 4    | 14   | 5   | 9   | 3   | 4   | 8   | 2   | 2   | 2   | 2   | 2   | 1   | 1   | 1   | 1   |     |     |     |     |     |     |     |     |     | 357 |     |
| %      | 22.9| 8.4 | 22.1 | 24.6 | 5.6  | 0.6 | 1.1  | 3.9  | 1.4 | 2.5 | 0.9 | 1.1 | 2.2 | 0.6 | 0.6 | 0.6 | 0.6 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |

*Note: The table includes detailed *csp1*-type-stratified epidemiologic data for isolates without documented susceptibility testing and azole susceptible isolates. The data is presented by origin, with counts for each origin type. The total number of isolates and the reference source are also provided.*
### Supplementary Table 2 (continued)

| origin | t01 | t02 | t03 | t04 | t05 | t06 | t07 | t08 | t09 | t10 | t11 | t12 | t13 | t14 | t15 | t16 | t17 | t18 | t19 | t20 | t21 | t22 | t23 | t24 | t25 | t26 | t27 | total | reference |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| **C) azole resistant isolates with TR34/L98H** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| NL     | 12  | 20  |     | 23  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 55  | (9)  |
| ES     |  9  |  1  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 10  | (4, 10)|
| DE     |  1  | 10  |  1  | 42  |     |     |     |  8  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 62  | (13, 14)|
| IR     |  5  |  2  |  1  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  9  | (11) |
| TZ     |  1  |  2  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  7  |     |     |     |     |     |     |     |     |     |     |  3  | (15) |
| TH     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  8  | (16) |
| UK     |  1  |  9  |  2  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 12  | (12) |
| CH     |  4  |  1  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  6  | (17) |
| CN     |  3  |  1  |  1  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  6  | (18) |
| CN     |  5  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  5  | (19) |
| CNb    |  2  |  1  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  8  | (19) |
| **sum** |  5  |  5  |  5  |  4  |  69 |     |     |  1  | 38  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 178 |
| **%**  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **D) azole resistant isolates with TR40-repeat alleles** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| ES     |  1  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  1  | (4, 10)|
| DE     |  5  |  1  |  4  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 10  | (13, 14, 20)|
| UK     |  1  |  3  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  1  |     |     |     |     |     |     |     |     |     |     |  1  | (12) |
| CN     |  4  |  2  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  6  | (19) |
| **sum** | 11  |  4  |  6  |     |     |     |     |  1  |  1  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 23  |
| **%**  |     |  41.2| 23.5| 23.5|     |     |     |  5.9|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| **E) resistant isolates with substitutions at M220** |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| DE     |  1  |  2  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  3  | (13, 14)|
| **%**  |     |  33.3| 66.7|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
Supplementary Table 2 (continued)

| origin | t01 | t02 | t03 | t04A | t04B | t05 | t06A | t06B | t07 | t08 | t09 | t10 | t11 | t12 | t13 | t14 | t15 | t16 | t17 | t18A | t18B | t19 | t20 | t21 | t22 | t23 | t24 | t25A | t25B | t25D | t26 | t27 | total | reference |
|--------|-----|-----|-----|------|------|-----|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| F)     |     |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| TH     | 3   |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 3 | (16)  |
| CH     | 1   |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1 | (17)  |
| DE     | 1   | 2   |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 3 | (14)  |
| ES     | 1   |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1 | (21)  |
| sum    | 2   | 5   | 1   |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 8 |      |
| %      | 41.2| 23.5| 23.5|      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 5.9| 5.9   |
| G)     |     |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| IR     | 1   | 1   | 2   |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 6 | (11)  |
| DE     | 2   | 1   | 4   |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 9 | (14)  |
| ES     |     | 1   |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1 | (21)  |
| sum    | 3   | 1   | 5   |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 16|      |
| %      | 18.7| 6.3 | 31.3| 18.7 |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 6.3| 6.3   |
| H)     |     |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| DE     | 1   |     |     |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1 | (14)  |
| NL     | 4   | 1   | 1   |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 7 | (9)    |
| ES     | 2   | 2   | 2   |      |      |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 6 | (4, 10)|

a country codes: NL: The Netherlands; OZ: Australia; CN: China, MX: Mexico, AR: Argentina; PE: Peru, ES: Spain; IR: Ireland; DE: Germany; UK: United Kingdom; TZ: Tanzania; TH: Thailand; CH: Switzerland; USA: United States of America; b allele type TR34/L98H/S297T/F495I
**Supplementary Table 3: details on genome data set**

(excel sheet) available from [https://github.com/oliverbader/Aspergillus_fumigatus_cyp51A](https://github.com/oliverbader/Aspergillus_fumigatus_cyp51A)

**Supplementary file 1: SNP alignment**

(.fasta.gz file) available from [https://github.com/oliverbader/Aspergillus_fumigatus_cyp51A](https://github.com/oliverbader/Aspergillus_fumigatus_cyp51A)

**Supplementary file 2: Data for Newick-format phylogenetic tree**

(.nhx file) available from [https://github.com/oliverbader/Aspergillus_fumigatus_cyp51A](https://github.com/oliverbader/Aspergillus_fumigatus_cyp51A)

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