

Phylogenetic Analysis of *Klebsiella pneumoniae* from Hospitalized Children, Pakistan

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Klebsiella pneumoniae shows increasing emergence of multidrug-resistant lineages, including strains resistant to all available antimicrobial drugs. We conducted whole-genome sequencing of 178 highly drug-resistant isolates from a tertiary hospital in Lahore, Pakistan. Phylogenetic analyses to place these isolates into global context demonstrate the expansion of multiple independent lineages, including *K. quasipneumoniae*.

Klebsiella spp. are gram-negative bacteria that are widely distributed in the environment, and *K. pneumoniae* is a common cause of infection in humans (1). Increasingly, *K. pneumoniae* is reported as a cause of invasive blood-borne infections, particularly in healthcare settings and in immunocompromised patients (2). Of concern is that infection-associated *K. pneumoniae* is often multidrug resistant (MDR) and can harbor resistance determinants against most, if not all, commonly used antimicrobial drugs, posing a major threat to public health. The World Health Organization recently highlighted finding new treatments against MDR *Enterobacteriaceae* (including *Klebsiella*) as priority 1 (critical) (<http://www.who.int/mediacentre/news/releases/2017/bacteria-antibiotics-needed/en/>).

K. pneumoniae is a major pathogen in economically developed settings, and multiple outbreaks in different countries have been reported. Less is known about its prevalence in economically challenged areas, including lower and middle income countries (LMIC). Reports are now appearing about *Klebsiella*-associated infections in Nepal (3) and in Indonesia, Laos, and Vietnam (1). *Klebsiella* can spread rapidly in hospital environments, and the

increasing prevalence of MDR strains has raised concern among major health organizations (4,5). Thus, high-resolution insight into the diversity of *Klebsiella* spp. isolated in LMICs will provide vital data for improving epidemiologic management of infections and for better understanding of the mechanisms of spread between LMICs and more developed countries.

The Study

Clinical samples were collected during a 22-month period (May 2010–February 2012) from The Children’s Hospital & The Institute of Child Health, Lahore (Lahore, Pakistan), the largest tertiary care hospital in the region (Figure 1, panel A). The hospital had a capacity of 650 beds during the study period but is under pressure to handle up to 2,000 inpatients at any given time. The primary catchment area is Lahore (population ≈10 million); the hospital also receives patients from the greater area of Punjab province (population ≈100 million) (Figure 1, panel A). The Ethical Committee of The Children’s Hospital & Institute of Child Health, Lahore, approved the study.

A total of 44,260 samples were collected in the course of routine sampling from children; 5,475 (12.4%) resulted in laboratory-positive cultures. Of these, 710 (13.0%) samples were positively identified as *K. pneumoniae*, the third most dominant isolate after *Escherichia coli* (1,336 [24.4%]) and coagulase-negative staphylococci (724 [13.2%]) (Figure 1, panel B). We screened all *K. pneumoniae* isolates for resistance to ceftazidime (30 µg disc, zone of inhibition ≤17 mm) or cefotaxime (30 µg disc, zone of inhibition ≤22 mm). We further tested *K. pneumoniae* isolates that were resistant to any of these indicator drugs using the Clinical and Laboratory Standards Institute combined-disc confirmatory test (6); extended-spectrum β-lactamase (ESBL) production was confirmed when the zone of inhibition by either cephalosporin drug increased by ≥5 mm in the presence of clavulanate. A total of 214 of *K. pneumoniae* isolates were ESBL-positive (Figure 1, panel C); most were isolated from children with bloodstream infections (Figure 1, panel D). The outcomes were severe, especially among neonatal patients (Figure 1, panel D); 56 died, 31 were taken home against medical advice, and 127 were discharged (Figure 1, panel D). Almost all patients infected

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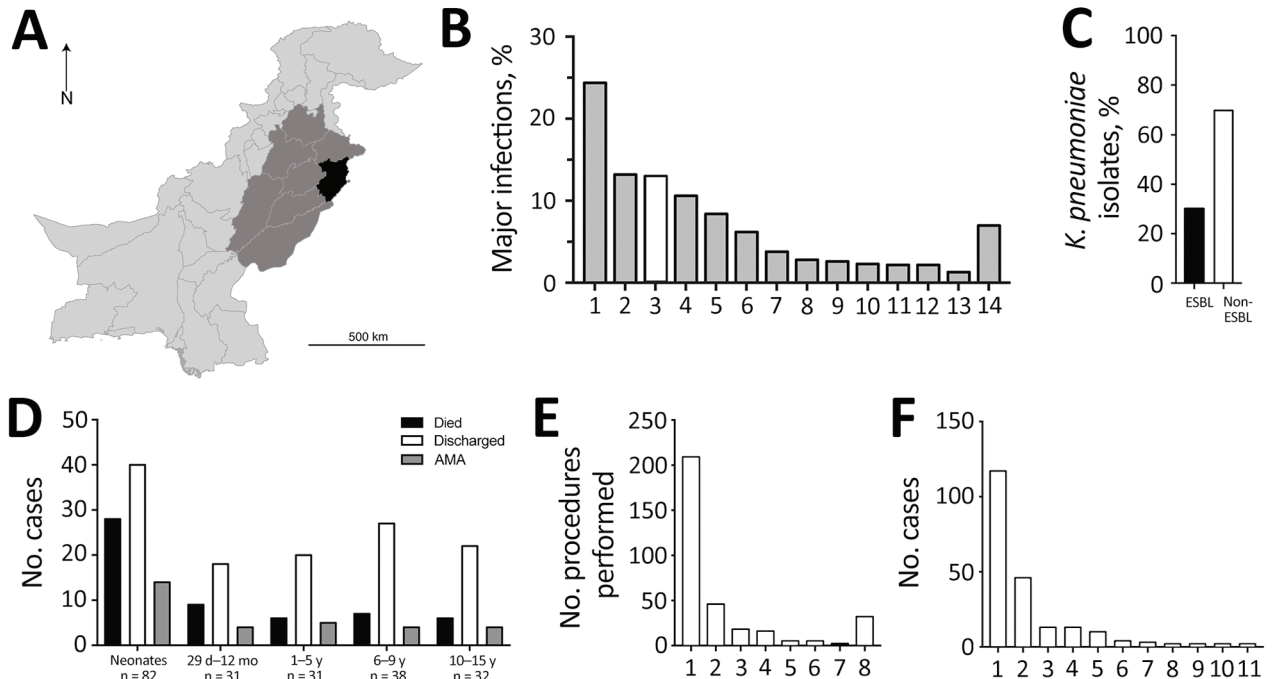


Figure 1. Statistical overview of bacterial isolates from clinical samples collected during May 2010–February 2012 from The Children’s Hospital & The Institute of Child Health, Lahore, Pakistan. A) Map of Pakistan highlighting the main catchment area of Lahore (black, population ≈10 million) and the wider area of Punjab (medium gray, population ≈100 million). B) A total of 5,475 samples collected from children resulted in laboratory-positive cultures; the 5 most frequently occurring bacterial species accounted for ≈70% of total bacterial infections, and *Klebsiella pneumoniae* (white bar) was the third most dominant (710 isolates). 1, *Escherichia coli*; 2, coagulase-negative *Staphylococcus*; 3, *K. pneumoniae*; 4, *Pseudomonas aeruginosa*; 5, *K. oxytoca*; 6, *Staphylococcus aureus*; 7, *Acinetobacter* spp.; 8, *Enterococcus faecalis*; 9, *Citrobacter* spp.; 10, *Streptococcus pyogenes*; 11, *Burkholderia cepacia*; 12, *Enterobacter cloacae*; 13, *Salmonella enterica* var. Typhi; 14, others (>100 species). C) The proportion of ESBL-producing *K. pneumoniae* among all *K. pneumoniae* isolates demonstrated high prevalence of antimicrobial resistance. D) A total of 38.3% of ESBL-producing *K. pneumoniae* infections occurred in neonates (<29 d), an age group that also showed the highest fatality rate (34.1%). Patients who were removed from the hospital against medical advice (AMA) typically were critically ill and were taken home by the family to avoid dying in the hospital. E) The apparent hierarchy shown in panel E closely correlated with interventions given. IV line (97.7%), urinary catheter (27.5%), and ETT (8.4%) were the 3 most commonly administered procedures among sampled patients, although no temporal relationship between procedure and sample collection could be established. 1, IV line; 2, urinary catheter; 3, ETT; 4, PD catheter; 5, surgery; 6, NG tube; 7, CVP; 8, others. F) A total of 54.6% of ESBL-producing *K. pneumoniae* isolates were from patient blood samples, followed by urine (21.5%), CSF (6%), and ETT (6%). 1, Blood; 2, urine; 3, CSF; 4, ETT; 5, PD catheter; 6, tracheal secretions; 7, pus; 8, CVP tip; 9, ear swab; 10, pleural fluid; 11, wound swab. CSF, cerebrospinal fluid; CVP, central venous catheter tip; ESBL, extended-spectrum β-lactamase; ETT, endotracheal tube; IV, intravenous; NG, nasogastric; PD, peritoneal dialysis catheter. The regional map was derived from the Global Administrative Areas online resource (<http://www.gadm.org/>).

with ESBL *Klebsiella* had received an intravenous line (209 [97.7%]) (Figure 1, panels E,F), and a high number received a urinary catheter (46 [21.5%]).

We performed whole-genome sequencing on 178 isolates (online Technical Appendix Table 1, <https://wwwnc.cdc.gov/EID/article/23/11/17-0833-Techapp1.pdf>). We prepared Illumina sequencing libraries (Illumina, San Diego, CA, USA) with a 450-bp insert size according to the manufacturer’s protocols and sequenced them on an Illumina HiSeq2000 with 100-bp-long paired-end reads before assembly using an open-source high-throughput assembly and improvement pipeline as described (7) (<https://github.com/sanger-pathogens/>) and annotated using prokka (8). Initial clustering using mash (9) enabled aligning of these isolates to published reference sequences (online Technical

Appendix Figure 1, panel A). The clustering indicated a strong structure for the isolates that fell within the species *K. pneumoniae* (online Technical Appendix Figure 1, panel B). However, the analysis also revealed a large group of sequences most similar to *K. quasipneumoniae*; closer inspection focusing on this species showed strongest similarity to subspecies *similipneumoniae* (online Technical Appendix Figure 1, panel C) (10). We combined several independent datasets: a large global collection (1); 2 hospital outbreaks obtained in a comparable time frame, 1 of which was based in Nepal in 2012 (3); and a hospital study from Spain that also focused on diversity within ESBL-producing strains (11) (online Technical Appendix Table 2). We applied the pan-genome pipeline Roary version 3.7.0 (12) with a blastp (<https://blast.ncbi.nlm.nih.gov/Blast.cgi?PAGE=Proteins>)

percentage identity of 90% and a core definition of 99%, resulting in a core gene alignment comprising 1,793 genes for all studies (Figure 2) and 3,486 genes for the strains of this study (online Technical Appendix Figure 2). We first extracted single-nucleotide polymorphisms using snp-sites version 2.3.2 (13), then calculated a maximum-likelihood tree using RAxML version 8.2.8 (14) with the general time-reversible model and 100 bootstrap repeats. The core gene phylogeny (Figure 2) shows a wide distribution of the isolates from Pakistan across different lineages rather than 1 clonal lineage. The diversity of our strain collection is further emphasized through the diversity of multilocus sequence types (STs). No single ST dominates (Figure 2 outer ring; online Technical Appendix Figure 2); however,

a large group of isolates belongs to ST15, which is known to be problematic. The presence of *K. quasipneumoniae* isolates agrees with an overall lower percentage of reads mapped against *K. pneumoniae* (online Technical Appendix Table 1) and with recent descriptions of virulent *K. quasipneumoniae* strains (1,9,15). Assessing the metadata in phylogenetic context highlights the association of the *K. quasipneumoniae* lineage with patients in the neonatal ward, suggestive of its nosocomial residency (online Technical Appendix Figure 2). However, other main lineages (e.g., ST15, ST48) show a dynamic spread across wards and age groups, indicating against ≥ 1 resident lineages but instead a frequent movement of *K. pneumoniae* through the hospital, general population, or both.

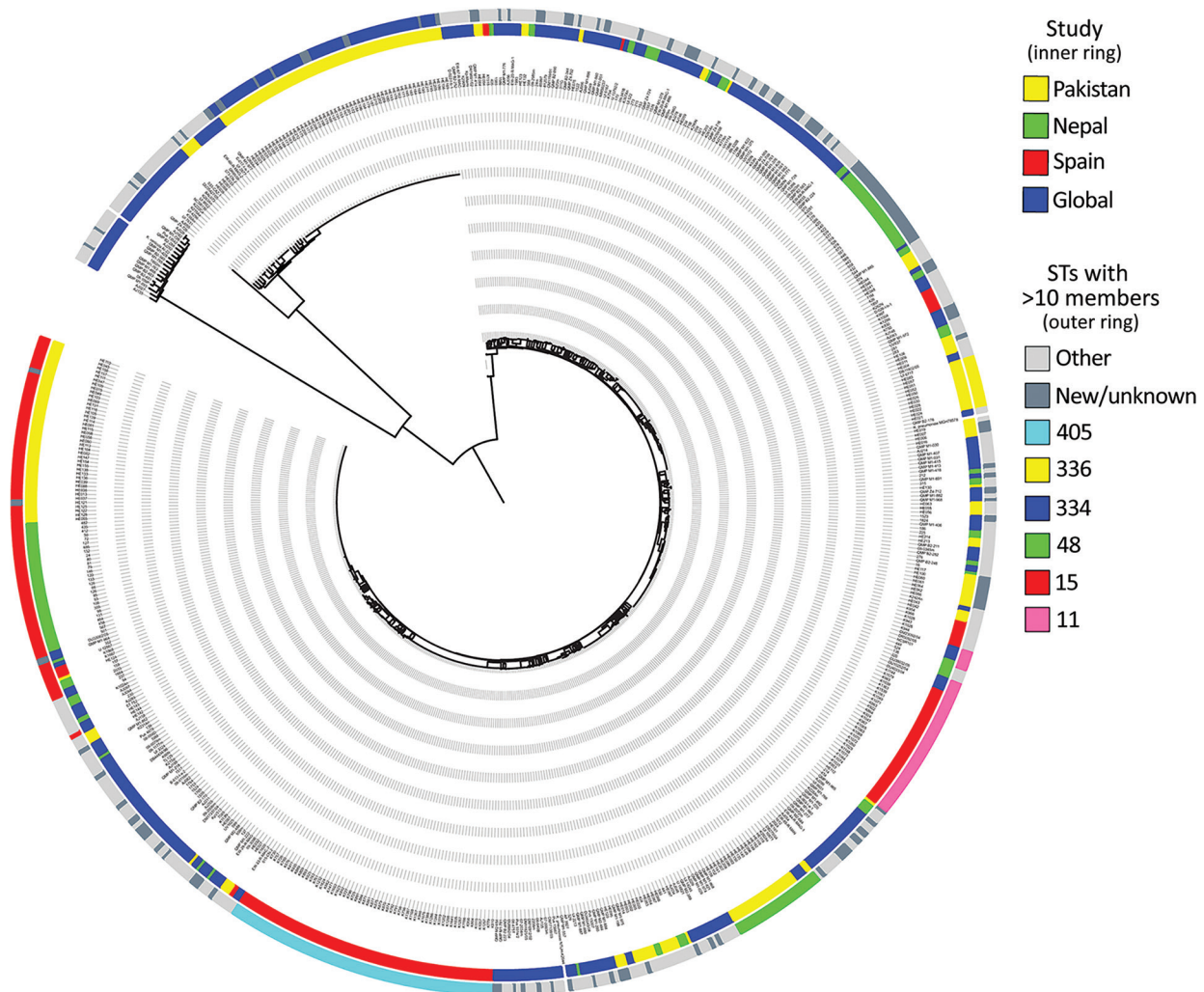


Figure 2. Phylogenetic analysis demonstrating the diversity of *Klebsiella pneumoniae* isolates from clinical samples collected during May 2010–February 2012 from The Children’s Hospital & The Institute of Child Health, Lahore, Pakistan, in a global context. The core gene tree based on the alignment derived from Roary (12) was calculated using RAxML (14) and shows the wide diversity of samples analyzed in this study (inner ring, yellow) in context with a large-scale global analysis (inner ring, blue [4]) and 2 hospital outbreaks, which show a more clonal pattern (inner ring: red, outbreak in Spain [11]; green, outbreak in Nepal [3]). The sequence types observed (outer ring) also reflect the diversity; most sequence types have <10 members even in this combined collection. STs, sequence types.

The high number of *K. quasipneumoniae* isolates, even if potentially restricted to most sequences derived from a lineage potentially resident in a specific ward, highlights the importance of a diverse set of sampling sites to be studied. It also highlights the need for continued monitoring of new emerging strains and that our knowledge of the diversity of potentially problematic lineages is far from exhaustive.

Conclusions

The *Klebsiella* isolates in this study represented the *Klebsiella* isolates routinely present in infections over a protracted period. Our findings highlight a consistent problem with ESBL-encoding strains belonging to a multitude of lineages. We observed sporadic single-isolate lineages, as well as smaller, related clusters of 5–10 strains per lineage, in addition to 2 larger clusters of strains. More studies are needed to better delineate the distinguishing features for successful spread and persistence of lineages such as the ST15 cluster. Also, the large spread of *K. quasipneumoniae* is unusual. Further intense monitoring of LMIC hospital environments is urgently needed to prevent the persistence of resident lineages with very high base-level drug resistance, which, through the inevitable acquisition of a few more genes, would lead to untreatable infections.

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Dr. Ejaz is a microbiologist who is working as Assistant Professor in Aljouf University, Aljouf, Saudi Arabia. He also worked at The Children's Hospital Lahore, Pakistan, and University of Melbourne, Australia. His primary research interests include medical bacteriology.

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Technical Appendix Table 2. GenBank accession numbers of published *Klebsiella pneumoniae* strains included in this analysis

ID	Reference	Sample accession		Accession	
		no.	Species	Strain	no.
10315_6#1	Chung The et al. (1)	ERS249010	<i>pneumoniae</i>	16	ERR349747
10315_6#10	Chung The et al. (1)	ERS249019	<i>pneumoniae</i>	94	ERR349756
10315_6#11	Chung The et al. (1)	ERS249020	<i>pneumoniae</i>	98	ERR349757
10315_6#13	Chung The et al. (1)	ERS249022	<i>pneumoniae</i>	108	ERR349759
10315_6#17	Chung The et al. (1)	ERS249026	<i>pneumoniae</i>	120	ERR349763
10315_6#18	Chung The et al. (1)	ERS249027	<i>pneumoniae</i>	126	ERR349764
10315_6#19	Chung The et al. (1)	ERS249028	<i>pneumoniae</i>	127	ERR349765
10315_6#2	Chung The et al. (1)	ERS249011	<i>pneumoniae</i>	24	ERR349748
10315_6#20	Chung The et al. (1)	ERS249029	<i>pneumoniae</i>	131	ERR349766
10315_6#21	Chung The et al. (1)	ERS249030	<i>pneumoniae</i>	132	ERR349767
10315_6#22	Chung The et al. (1)	ERS249031	<i>pneumoniae</i>	136	ERR349768
10315_6#23	Chung The et al. (1)	ERS249032	<i>pneumoniae</i>	137	ERR349769
10315_6#24	Chung The et al. (1)	ERS249033	<i>pneumoniae</i>	139	ERR349770
10315_6#27	Chung The et al. (1)	ERS249036	<i>pneumoniae</i>	153	ERR349773
10315_6#28	Chung The et al. (1)	ERS249037	<i>pneumoniae</i>	157	ERR349774
10315_6#29	Chung The et al. (1)	ERS249038	<i>pneumoniae</i>	159	ERR349775
10315_6#3	Chung The et al. (1)	ERS249012	<i>pneumoniae</i>	50	ERR349749
10315_6#31	Chung The et al. (1)	ERS249040	<i>pneumoniae</i>	170	ERR349777
10315_6#34	Chung The et al. (1)	ERS249043	<i>pneumoniae</i>	186	ERR349780
10315_6#38	Chung The et al. (1)	ERS249047	<i>pneumoniae</i>	209	ERR349784
10315_6#39	Chung The et al. (1)	ERS249048	<i>pneumoniae</i>	212	ERR349785
10315_6#40	Chung The et al. (1)	ERS249049	<i>pneumoniae</i>	214	ERR349786
10315_6#41	Chung The et al. (1)	ERS249050	<i>pneumoniae</i>	215	ERR349787
10315_6#42	Chung The et al. (1)	ERS249051	<i>pneumoniae</i>	225	ERR349788
10315_6#43	Chung The et al. (1)	ERS249052	<i>pneumoniae</i>	230	ERR349789
10315_6#44	Chung The et al. (1)	ERS249053	<i>pneumoniae</i>	234	ERR349790
10315_6#45	Chung The et al. (1)	ERS249054	<i>pneumoniae</i>	237	ERR349791
10315_6#49	Chung The et al. (1)	ERS249058	<i>pneumoniae</i>	270	ERR349795
10315_6#5	Chung The et al. (1)	ERS249014	<i>pneumoniae</i>	72	ERR349751
10315_6#51	Chung The et al. (1)	ERS249060	<i>pneumoniae</i>	273	ERR349797
10315_6#52	Chung The et al. (1)	ERS249061	<i>pneumoniae</i>	276	ERR349798
10315_6#53	Chung The et al. (1)	ERS249062	<i>pneumoniae</i>	281	ERR349799
10315_6#54	Chung The et al. (1)	ERS249063	<i>pneumoniae</i>	283	ERR349800
10315_6#57	Chung The et al. (1)	ERS249066	<i>pneumoniae</i>	305	ERR349803
10315_6#58	Chung The et al. (1)	ERS249067	<i>pneumoniae</i>	315	ERR349804
10315_6#59	Chung The et al. (1)	ERS249068	<i>pneumoniae</i>	320	ERR349805
10315_6#6	Chung The et al. (1)	ERS249015	<i>pneumoniae</i>	80	ERR349752
10315_6#60	Chung The et al. (1)	ERS249069	<i>pneumoniae</i>	321	ERR349806
10315_6#61	Chung The et al. (1)	ERS249070	<i>pneumoniae</i>	329	ERR349807
10315_6#62	Chung The et al. (1)	ERS249071	<i>pneumoniae</i>	352	ERR349808
10315_6#65	Chung The et al. (1)	ERS249074	<i>pneumoniae</i>	405	ERR349811
10315_6#66	Chung The et al. (1)	ERS249075	<i>pneumoniae</i>	412	ERR349812
10315_6#67	Chung The et al. (1)	ERS249076	<i>pneumoniae</i>	420	ERR349813
10315_6#68	Chung The et al. (1)	ERS249077	<i>pneumoniae</i>	422	ERR349814
10315_6#69	Chung The et al. (1)	ERS249078	<i>pneumoniae</i>	424	ERR349815
10315_6#7	Chung The et al. (1)	ERS249016	<i>pneumoniae</i>	81	ERR349753
10315_6#70	Chung The et al. (1)	ERS249079	<i>pneumoniae</i>	426	ERR349816
10315_6#71	Chung The et al. (1)	ERS249080	<i>pneumoniae</i>	432	ERR349817
10315_6#72	Chung The et al. (1)	ERS249081	<i>pneumoniae</i>	434	ERR349818
10315_6#73	Chung The et al. (1)	ERS249082	<i>pneumoniae</i>	435	ERR349819
10315_6#74	Chung The et al. (1)	ERS249083	<i>pneumoniae</i>	441	ERR349820
10315_6#75	Chung The et al. (1)	ERS249084	<i>pneumoniae</i>	446	ERR349821
10315_6#76	Chung The et al. (1)	ERS249085	<i>pneumoniae</i>	448	ERR349822
10315_6#77	Chung The et al. (1)	ERS249086	<i>pneumoniae</i>	458	ERR349823
10315_6#78	Chung The et al. (1)	ERS249087	<i>pneumoniae</i>	482	ERR349824
10315_6#79	Chung The et al. (1)	ERS249088	<i>pneumoniae</i>	484	ERR349825
10315_6#8	Chung The et al. (1)	ERS249017	<i>pneumoniae</i>	86	ERR349754
10315_6#80	Chung The et al. (1)	ERS249089	<i>pneumoniae</i>	486	ERR349826
10315_6#82	Chung The et al. (1)	ERS249091	<i>pneumoniae</i>	501	ERR349828
10315_6#87	Chung The et al. (1)	ERS249096	<i>pneumoniae</i>	519	ERR349833
10315_6#88	Chung The et al. (1)	ERS249097	<i>pneumoniae</i>	524	ERR349834
10315_6#89	Chung The et al. (1)	ERS249098	<i>pneumoniae</i>	526	ERR349835
10315_6#9	Chung The et al. (1)	ERS249018	<i>pneumoniae</i>	93	ERR349755
10315_6#92	Chung The et al. (1)	ERS249101	<i>pneumoniae</i>	539	ERR349838
10315_6#93	Chung The et al. (1)	ERS249102	<i>pneumoniae</i>	540	ERR349839
10315_6#95	Chung The et al. (1)	ERS249104	<i>pneumoniae</i>	544	ERR349841

ID	Reference	Sample accession no.	Species	Strain	Accession no.
10315_6#96	Chung The et al. (1)	ERS249105	<i>pneumoniae</i>	550	ERR349842
10356_5#76	Chung The et al. (1)	ERS249106	<i>pneumoniae</i>	558	ERR349843
10356_5#77	Chung The et al. (1)	ERS249107	<i>pneumoniae</i>	567	ERR349844
10356_5#78	Chung The et al. (1)	ERS249108	<i>pneumoniae</i>	568	ERR349845
10356_5#79	Chung The et al. (1)	ERS249109	<i>pneumoniae</i>	570	ERR349846
10356_5#80	Chung The et al. (1)	ERS249110	<i>pneumoniae</i>	573	ERR349847
10356_5#81	Chung The et al. (1)	ERS249111	<i>pneumoniae</i>	574	ERR349848
10356_5#82	Chung The et al. (1)	ERS249112	<i>pneumoniae</i>	577	ERR349849
10356_5#85	Chung The et al. (1)	ERS249115	<i>pneumoniae</i>	586	ERR349852
10356_5#86	Chung The et al. (1)	ERS249116	<i>pneumoniae</i>	588	ERR349853
10356_5#87	Chung The et al. (1)	ERS249117	<i>pneumoniae</i>	599	ERR349854
9878_1#11	Chung The et al. (1)	ERS237577	<i>pneumoniae</i>	587	ERR317538
9878_1#12	Chung The et al. (1)	ERS237578	<i>pneumoniae</i>	610	ERR317539
9878_1#2	Chung The et al. (1)	ERS237568	<i>pneumoniae</i>	79	ERR317529
9878_1#3	Chung The et al. (1)	ERS237569	<i>pneumoniae</i>	85	ERR317530
9878_1#4	Chung The et al. (1)	ERS237570	<i>pneumoniae</i>	128	ERR317531
9878_1#5	Chung The et al. (1)	ERS237571	<i>pneumoniae</i>	133	ERR317532
9878_1#6	Chung The et al. (1)	ERS237572	<i>pneumoniae</i>	146	ERR317533
9878_1#8	Chung The et al. (1)	ERS237574	<i>pneumoniae</i>	442	ERR317535
9878_1#9	Chung The et al. (1)	ERS237575	<i>pneumoniae</i>	478	ERR317536
5193_7#7	Holt et al. (2)	ERS011884	<i>pneumoniae</i>	QMP B2-252	ERR025536
5151_6#8	Holt et al. (2)	ERS011957	<i>pneumoniae</i>	QMP M1-378	ERR025160
5235_2#6	Holt et al. (2)	ERS011991	<i>pneumoniae</i>	QMP M1-029	ERR025613
5197_8#7	Holt et al. (2)	ERS011896	<i>pneumoniae</i>	QMP B2-282	ERR025588
5151_2#11	Holt et al. (2)	ERS011924	<i>pneumoniae</i>	QMP B2-344	ERR025113
5151_3#5	Holt et al. (2)	ERS011930	<i>pneumoniae</i>	QMP M1-030	ERR025131
5235_3#4	Holt et al. (2)	ERS012001	<i>pneumoniae</i>	QMP M2-654	ERR025624
5235_3#1	Holt et al. (2)	ERS011998	<i>pneumoniae</i>	QMP M2-484	ERR025618
5151_3#6	Holt et al. (2)	ERS011931	<i>pneumoniae</i>	QMP M1-031	ERR025132
5235_2#8	Holt et al. (2)	ERS011993	<i>pneumoniae</i>	QMP M2-389	ERR025615
5151_5#11	Holt et al. (2)	ERS011948	<i>pneumoniae</i>	QMP M1-766	ERR025139
5235_3#7	Holt et al. (2)	ERS012004	<i>pneumoniae</i>	QMP M2-684	ERR025627
5235_3#2	Holt et al. (2)	ERS011999	<i>pneumoniae</i>	QMP M2-488	ERR025622
5151_6#7	Holt et al. (2)	ERS011956	<i>pneumoniae</i>	QMP M1-376	ERR025159
5151_6#6	Holt et al. (2)	ERS011955	<i>pneumoniae</i>	QMP M1-375	ERR025158
5151_3#10	Holt et al. (2)	ERS011935	<i>pneumoniae</i>	QMP M1-051	ERR025125
5197_7#7	Holt et al. (2)	ERS011872	<i>pneumoniae</i>	QMP B2-248	ERR025575
5151_6#1	Holt et al. (2)	ERS011950	<i>pneumoniae</i>	QMP M1-200	ERR025150
5151_5#7	Holt et al. (2)	ERS011944	<i>pneumoniae</i>	QMP M1-728	ERR025146
5235_3#11	Holt et al. (2)	ERS012008	<i>pneumoniae</i>	QMP Z4-702	ERR025620
5151_5#8	Holt et al. (2)	ERS011945	<i>pneumoniae</i>	QMP M1-761	ERR025147
5299_1#2	Holt et al. (2)	ERS011963	<i>pneumoniae</i>	QMP M1-821	ERR025983
5151_5#2	Holt et al. (2)	ERS011939	<i>pneumoniae</i>	QMP M1-559	ERR025141
5151_6#5	Holt et al. (2)	ERS011954	<i>pneumoniae</i>	QMP M1-222	ERR025157
5235_3#12	Holt et al. (2)	ERS012009	<i>pneumoniae</i>	QMP Z4-724	ERR025621
5151_3#2	Holt et al. (2)	ERS011927	<i>pneumoniae</i>	QMP B2-563	ERR025128
5151_6#3	Holt et al. (2)	ERS011952	<i>pneumoniae</i>	QMP M1-218	ERR025155
5151_6#2	Holt et al. (2)	ERS011951	<i>pneumoniae</i>	QMP M1-217	ERR025154
5151_5#3	Holt et al. (2)	ERS011940	<i>pneumoniae</i>	QMP M1-560	ERR025142
5193_2#7	Holt et al. (2)	ERS011812	<i>pneumoniae</i>	QMP B2-176	ERR025484
5299_7#7	Holt et al. (2)	ERS012052	<i>pneumoniae</i>	QMP Z4-716	ERR025999
5151_6#4	Holt et al. (2)	ERS011953	<i>pneumoniae</i>	QMP M1-220	ERR025156
5151_3#11	Holt et al. (2)	ERS011936	<i>pneumoniae</i>	QMP M1-198	ERR025126
5235_6#7	Holt et al. (2)	ERS012028	<i>pneumoniae</i>	QMP Z4-709	ERR025653
5235_7#7	Holt et al. (2)	ERS012040	<i>pneumoniae</i>	QMP Z4-712	ERR025666
5193_6#7	Holt et al. (2)	ERS011860	<i>pneumoniae</i>	QMP B2-228	ERR025523
5299_1#1	Holt et al. (2)	ERS011962	<i>pneumoniae</i>	QMP M1-781	ERR025979
5193_5#7	Holt et al. (2)	ERS011848	<i>pneumoniae</i>	QMP B2-223	ERR025510
5151_5#4	Holt et al. (2)	ERS011941	<i>pneumoniae</i>	QMP M1-561	ERR025143
5151_5#5	Holt et al. (2)	ERS011942	<i>pneumoniae</i>	QMP M1-562	ERR025144
5299_1#4	Holt et al. (2)	ERS011965	<i>pneumoniae</i>	QMP M1-826	ERR025985
5299_1#3	Holt et al. (2)	ERS011964	<i>pneumoniae</i>	QMP M1-822	ERR025984
5151_5#1	Holt et al. (2)	ERS011938	<i>pneumoniae</i>	QMP M1-557	ERR025137
5197_2#7	Holt et al. (2)	ERS011825	<i>pneumoniae</i>	QMP B2-211	ERR025562
5235_8#7	Holt et al. (2)	ERS011789	<i>pneumoniae</i>	QMP B2-090	ERR025678
5193_1#7	Holt et al. (2)	ERS011800	<i>pneumoniae</i>	QMP B2-170	ERR025471
5193_3#12	Holt et al. (2)	ERS011841	<i>pneumoniae</i>	D-022-I-b-1	ERR025491
5193_6#2	Holt et al. (2)	ERS011855	<i>pneumoniae</i>	EW-67-R-MAC	ERR025518

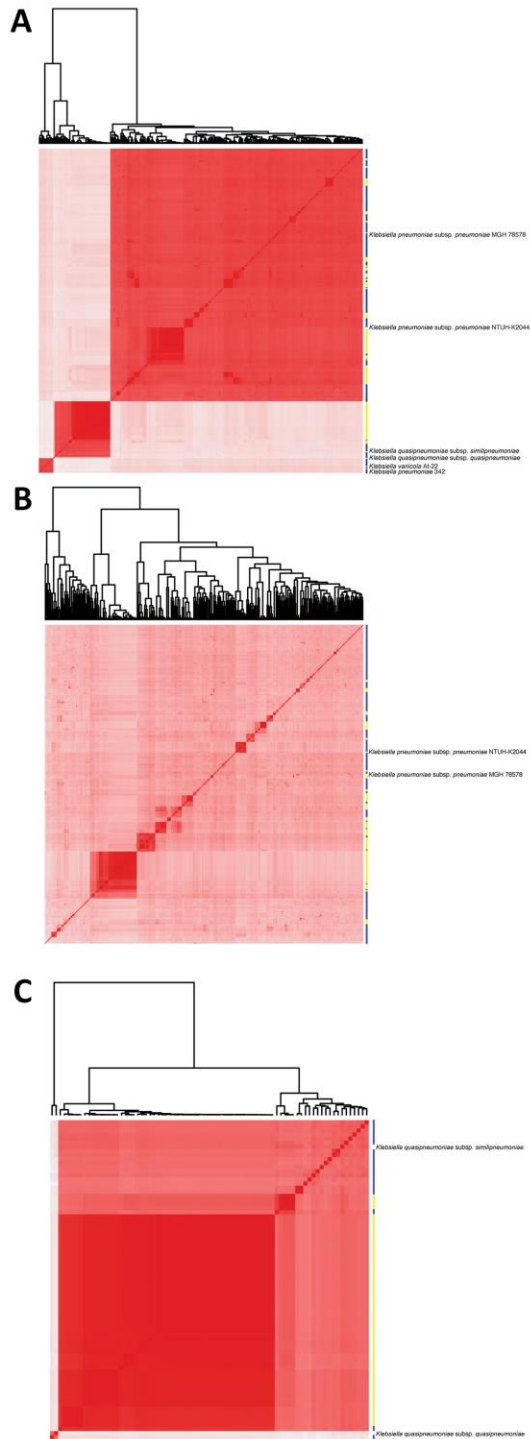
ID	Reference	Sample accession no.	Species	Strain	Accession no.
5193_5#8	Holt et al. (2)	ERS011849	<i>pneumoniae</i>	EW-20-R-MAG-1	ERR025511
5193_2#8	Holt et al. (2)	ERS011813	<i>pneumoniae</i>	K21Sp	ERR025485
5193_3#7	Holt et al. (2)	ERS011836	<i>pneumoniae</i>	K296N	ERR025497
5197_2#10	Holt et al. (2)	ERS011827	<i>pneumoniae</i>	K261An	ERR025554
5193_3#10	Holt et al. (2)	ERS011839	<i>pneumoniae</i>	B-013-I-a-2	ERR025489
5193_5#2	Holt et al. (2)	ERS011843	<i>pneumoniae</i>	015-CN-2	ERR025505
5193_5#9	Holt et al. (2)	ERS011850	<i>pneumoniae</i>	EW-20-R-MAC-1	ERR025512
5197_2#6	Holt et al. (2)	ERS011823	<i>pneumoniae</i>	K228An	ERR025561
5193_3#9	Holt et al. (2)	ERS011838	<i>pneumoniae</i>	A-003-I-a-1	ERR025499
5193_3#4	Holt et al. (2)	ERS011833	<i>pneumoniae</i>	K280N	ERR025494
5197_2#8	Holt et al. (2)	ERS011824	<i>pneumoniae</i>	K231An	ERR025563
5193_5#11	Holt et al. (2)	ERS011852	<i>pneumoniae</i>	EW-33-R-MAC-2	ERR025503
5193_2#12	Holt et al. (2)	ERS011817	<i>pneumoniae</i>	K77An	ERR025478
5197_2#9	Holt et al. (2)	ERS011826	<i>pneumoniae</i>	K242An	ERR025564
5193_5#10	Holt et al. (2)	ERS011851	<i>pneumoniae</i>	EW-29-R-MAG	ERR025502
5197_2#3	Holt et al. (2)	ERS011820	<i>pneumoniae</i>	K113N	ERR025558
5193_6#3	Holt et al. (2)	ERS011856	<i>pneumoniae</i>	EW-68-R-MAC-1	ERR025519
5197_2#1	Holt et al. (2)	ERS011818	<i>pneumoniae</i>	K86N	ERR025553
5193_3#8	Holt et al. (2)	ERS011837	<i>pneumoniae</i>	K307An	ERR025498
5193_3#5	Holt et al. (2)	ERS011834	<i>pneumoniae</i>	K282Ax	ERR025495
5193_2#9	Holt et al. (2)	ERS011814	<i>pneumoniae</i>	K35N	ERR025486
5193_2#11	Holt et al. (2)	ERS011816	<i>pneumoniae</i>	K53N	ERR025477
5193_3#6	Holt et al. (2)	ERS011835	<i>pneumoniae</i>	K290N	ERR025496
5193_5#1	Holt et al. (2)	ERS011842	<i>pneumoniae</i>	D-026-I-b-1	ERR025501
5197_2#11	Holt et al. (2)	ERS011828	<i>pneumoniae</i>	K262N	ERR025555
5193_6#4	Holt et al. (2)	ERS011857	<i>pneumoniae</i>	EW-85-R-MAN	ERR025520
5193_5#12	Holt et al. (2)	ERS011853	<i>pneumoniae</i>	EW-44-R-MAG-1	ERR025504
5197_2#2	Holt et al. (2)	ERS011819	<i>pneumoniae</i>	K102An	ERR025557
5235_2#3	Holt et al. (2)	ERS011988	<i>pneumoniae</i>	QMP M1-975	ERR025610
5235_2#2	Holt et al. (2)	ERS011987	<i>pneumoniae</i>	QMP M1-974	ERR025609
5235_1#11	Holt et al. (2)	ERS011984	<i>pneumoniae</i>	QMP M1-968	ERR025594
5193_8#8	Holt et al. (2)	ERS011909	<i>pneumoniae</i>	DU33062/05	ERR025550
5193_8#5	Holt et al. (2)	ERS011906	<i>pneumoniae</i>	DR5092/05	ERR025547
5193_2#6	Holt et al. (2)	ERS011811	<i>pneumoniae</i>	UV1714	ERR025483
5193_2#5	Holt et al. (2)	ERS011810	<i>pneumoniae</i>	UV1625	ERR025482
5193_2#1	Holt et al. (2)	ERS011806	<i>pneumoniae</i>	UV1172	ERR025475
5193_1#12	Holt et al. (2)	ERS011805	<i>pneumoniae</i>	UV937	ERR025465
5193_2#2	Holt et al. (2)	ERS011807	<i>pneumoniae</i>	NCSR101	ERR025479
5235_1#3	Holt et al. (2)	ERS011976	<i>pneumoniae</i>	QMP M1-892	ERR025597
5299_1#9	Holt et al. (2)	ERS011970	<i>pneumoniae</i>	QMP M1-885	ERR025990
5299_1#10	Holt et al. (2)	ERS011971	<i>pneumoniae</i>	QMP M1-886	ERR025980
5299_1#7	Holt et al. (2)	ERS011968	<i>pneumoniae</i>	QMP M1-882	ERR025988
5299_1#11	Holt et al. (2)	ERS011972	<i>pneumoniae</i>	QMP M1-887	ERR025981
5235_3#6	Holt et al. (2)	ERS012003	<i>pneumoniae</i>	QMP M1-860	ERR025626
5235_1#6	Holt et al. (2)	ERS011979	<i>pneumoniae</i>	QMP M1-896	ERR025600
5299_1#8	Holt et al. (2)	ERS011969	<i>pneumoniae</i>	QMP M1-884	ERR025989
5235_1#2	Holt et al. (2)	ERS011975	<i>pneumoniae</i>	QMP M1-891	ERR025596
5151_2#6	Holt et al. (2)	ERS011919	<i>pneumoniae</i>	DU8882/04	ERR025119
5151_2#3	Holt et al. (2)	ERS011916	<i>pneumoniae</i>	DM17337/04	ERR025116
5151_2#10	Holt et al. (2)	ERS011923	<i>pneumoniae</i>	DU46543/08	ERR025112
5193_8#3	Holt et al. (2)	ERS011904	<i>pneumoniae</i>	DU4033/04	ERR025545
5193_8#6	Holt et al. (2)	ERS011907	<i>pneumoniae</i>	DU10252/04	ERR025548
5193_8#1	Holt et al. (2)	ERS011902	<i>pneumoniae</i>	DM23092/04	ERR025540
5193_8#10	Holt et al. (2)	ERS011911	<i>pneumoniae</i>	DU38032/05	ERR025541
5235_5#6	Holt et al. (2)	ERS012015	<i>pneumoniae</i>	09-309B	ERR025639
5235_6#2	Holt et al. (2)	ERS012023	<i>pneumoniae</i>	09-341B	ERR025648
5235_8#8	Holt et al. (2)	ERS011790	<i>pneumoniae</i>	71B	ERR025679
5235_8#2	Holt et al. (2)	ERS011784	<i>pneumoniae</i>	08-049B	ERR025673
5193_1#9	Holt et al. (2)	ERS011802	<i>pneumoniae</i>	08-058D	ERR025473
5235_5#11	Holt et al. (2)	ERS012020	<i>pneumoniae</i>	09-332B	ERR025633
5150_1#3	Holt et al. (2)	ERS005743	<i>pneumoniae</i>	AJ049	ERR024822
5150_2#5	Holt et al. (2)	ERS005757	<i>pneumoniae</i>	AJ056	ERR024837
5150_3#6	Holt et al. (2)	ERS005770	<i>pneumoniae</i>	AJ158	ERR024851

ID	Reference	Sample accession no.	Species	Strain	Accession no.
5150_5#7	Holt et al. (2)	ERS005783	<i>pneumoniae</i>	AJ229	ERR025107
5150_2#3	Holt et al. (2)	ERS005756	<i>pneumoniae</i>	AJ146	ERR024835
5150_2#7	Holt et al. (2)	ERS005759	<i>pneumoniae</i>	AJ082	ERR024839
5150_3#9	Holt et al. (2)	ERS005773	<i>pneumoniae</i>	AJ188	ERR024854
5150_5#9	Holt et al. (2)	ERS005785	<i>pneumoniae</i>	AJ278	ERR025109
5150_1#11	Holt et al. (2)	ERS005751	<i>pneumoniae</i>	AJ034	ERR024819
5150_1#2	Holt et al. (2)	ERS005742	<i>pneumoniae</i>	AJ048	ERR024821
5150_5#5	Holt et al. (2)	ERS005781	<i>pneumoniae</i>	AJ218	ERR025105
5150_3#1	Holt et al. (2)	ERS005765	<i>pneumoniae</i>	AJ155	ERR024843
5150_2#8	Holt et al. (2)	ERS005760	<i>pneumoniae</i>	AJ083	ERR024840
5150_2#4	Holt et al. (2)	ERS005755	<i>pneumoniae</i>	AJ148	ERR024836
5150_1#4	Holt et al. (2)	ERS005744	<i>pneumoniae</i>	AJ054	ERR024823
5150_2#11	Holt et al. (2)	ERS005763	<i>pneumoniae</i>	AJ097	ERR024832
5150_2#10	Holt et al. (2)	ERS005762	<i>pneumoniae</i>	AJ094	ERR024831
5150_3#11	Holt et al. (2)	ERS005775	<i>pneumoniae</i>	AJ205	ERR024845
5150_3#3	Holt et al. (2)	ERS005767	<i>pneumoniae</i>	AJ211	ERR024848
5193_7#3	Holt et al. (2)	ERS011880	<i>pneumoniae</i>	U 16821	ERR025532
5193_7#2	Holt et al. (2)	ERS011879	<i>pneumoniae</i>	U 13792/2	ERR025531
5193_7#1	Holt et al. (2)	ERS011878	<i>pneumoniae</i>	U 12567	ERR025527
5197_7#8	Holt et al. (2)	ERS011873	<i>pneumoniae</i>	Pus 15987	ERR025576
5151_5#12	Holt et al. (2)	ERS011949	<i>pneumoniae</i>	QMP M1-771	ERR025140
5235_3#8	Holt et al. (2)	ERS012005	<i>pneumoniae</i>	QMP M1-862	ERR025628
5235_3#9	Holt et al. (2)	ERS012006	<i>pneumoniae</i>	QMP M1-868	ERR025629
5235_3#5	Holt et al. (2)	ERS012002	<i>pneumoniae</i>	QMP M1-776	ERR025625
5193_8#12	Holt et al. (2)	ERS011913	<i>pneumoniae</i>	DR19891/02	ERR025543
5193_8#2	Holt et al. (2)	ERS011903	<i>pneumoniae</i>	DB44834/96	ERR025544
5193_8#4	Holt et al. (2)	ERS011905	<i>pneumoniae</i>	DB11802/05	ERR025546
5151_2#8	Holt et al. (2)	ERS011921	<i>pneumoniae</i>	DX259/08	ERR025121
5151_2#5	Holt et al. (2)	ERS011918	<i>pneumoniae</i>	DB270/04	ERR025118
5151_2#1	Holt et al. (2)	ERS011914	<i>pneumoniae</i>	DM16912/02	ERR025111
5151_2#2	Holt et al. (2)	ERS011915	<i>pneumoniae</i>	DM17138/03	ERR025115
5151_2#4	Holt et al. (2)	ERS011917	<i>pneumoniae</i>	DM11825/05	ERR025117
5193_8#11	Holt et al. (2)	ERS011912	<i>pneumoniae</i>	DM1159/01	ERR025542
5299_7#1	Holt et al. (2)	ERS012046	<i>pneumoniae</i>	1824	ERR025992
5299_7#9	Holt et al. (2)	ERS012054	<i>pneumoniae</i>	1522	ERR026001
5299_7#6	Holt et al. (2)	ERS012051	<i>pneumoniae</i>	2024	ERR025998
5235_6#11	Holt et al. (2)	ERS012032	<i>pneumoniae</i>	1517	ERR025646
5299_7#3	Holt et al. (2)	ERS012048	<i>pneumoniae</i>	1896	ERR025995
5299_7#5	Holt et al. (2)	ERS012050	<i>pneumoniae</i>	1993	ERR025997
5235_6#12	Holt et al. (2)	ERS012033	<i>pneumoniae</i>	1523	ERR025647
5235_7#4	Holt et al. (2)	ERS012037	<i>pneumoniae</i>	1576	ERR025663
5235_7#5	Holt et al. (2)	ERS012038	<i>pneumoniae</i>	1585	ERR025664
5235_7#6	Holt et al. (2)	ERS012039	<i>pneumoniae</i>	1586	ERR025665
5299_7#2	Holt et al. (2)	ERS012047	<i>pneumoniae</i>	1884	ERR025994
5299_7#4	Holt et al. (2)	ERS012049	<i>pneumoniae</i>	1897	ERR025996
5235_7#8	Holt et al. (2)	ERS012041	<i>pneumoniae</i>	1612	ERR025667
5235_7#12	Holt et al. (2)	ERS012045	<i>pneumoniae</i>	1789	ERR025660
5235_7#11	Holt et al. (2)	ERS012044	<i>pneumoniae</i>	1765	ERR025659
5235_7#9	Holt et al. (2)	ERS012042	<i>pneumoniae</i>	1753	ERR025668
5235_7#10	Holt et al. (2)	ERS012043	<i>pneumoniae</i>	1764	ERR025658
5235_8#3	Holt et al. (2)	ERS011785	<i>pneumoniae</i>	71M	ERR025674
5235_8#6	Holt et al. (2)	ERS011788	<i>pneumoniae</i>	08-0116m	ERR025677
5235_6#10	Holt et al. (2)	ERS012031	<i>pneumoniae</i>	805m	ERR025645
5235_6#9	Holt et al. (2)	ERS012030	<i>pneumoniae</i>	558m	ERR025655
5235_5#5	Holt et al. (2)	ERS012014	<i>pneumoniae</i>	09-2006m	ERR025638
5235_5#8	Holt et al. (2)	ERS012017	<i>pneumoniae</i>	09-2072m	ERR025641
5235_5#2	Holt et al. (2)	ERS012011	<i>pneumoniae</i>	09-2503m	ERR025635
5235_8#4	Holt et al. (2)	ERS011786	<i>pneumoniae</i>	08-0345m	ERR025675
5235_8#5	Holt et al. (2)	ERS011787	<i>pneumoniae</i>	24m	ERR025676
5235_6#3	Holt et al. (2)	ERS012024	<i>pneumoniae</i>	09-2985m	ERR025649
5193_1#4	Holt et al. (2)	ERS011797	<i>pneumoniae</i>	07-0003m	ERR025468
5235_6#8	Holt et al. (2)	ERS012029	<i>pneumoniae</i>	2358m	ERR025654
5193_1#8	Holt et al. (2)	ERS011801	<i>pneumoniae</i>	08-475T	ERR025472
5193_1#6	Holt et al. (2)	ERS011799	<i>pneumoniae</i>	07-2034m	ERR025470
5193_1#11	Holt et al. (2)	ERS011804	<i>pneumoniae</i>	08-1177m	ERR025464
5193_1#5	Holt et al. (2)	ERS011798	<i>pneumoniae</i>	09-0079m	ERR025469
5193_1#1	Holt et al. (2)	ERS011794	<i>pneumoniae</i>	59M	ERR025462
5235_6#6	Holt et al. (2)	ERS012027	<i>pneumoniae</i>	620m	ERR025652

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5150_5#3	Holt et al. (2)	ERS005779	<i>pneumoniae</i>	AJ299	ERR025103
5150_1#5	Holt et al. (2)	ERS005745	<i>pneumoniae</i>	AJ006	ERR024824
5150_5#1	Holt et al. (2)	ERS005777	<i>pneumoniae</i>	AJ214	ERR025098
5150_5#10	Holt et al. (2)	ERS005786	<i>pneumoniae</i>	AJ281	ERR025099
5150_5#11	Holt et al. (2)	ERS005787	<i>pneumoniae</i>	AJ289	ERR025100
5197_8#11	Holt et al. (2)	ERS011900	<i>pneumoniae</i>	UI 14245	ERR025581
5197_8#1	Holt et al. (2)	ERS011890	<i>pneumoniae</i>	UI 6167	ERR025579
5197_7#2	Holt et al. (2)	ERS011867	<i>pneumoniae</i>	Pus 4878	ERR025570
5193_7#5	Holt et al. (2)	ERS011882	<i>pneumoniae</i>	UI 522	ERR025534
5193_7#9	Holt et al. (2)	ERS011886	<i>pneumoniae</i>	UI 3324	ERR025538
5197_8#4	Holt et al. (2)	ERS011893	<i>pneumoniae</i>	UI 8601	ERR025585
5197_8#12	Holt et al. (2)	ERS011901	<i>pneumoniae</i>	UI 15398	ERR025582
5197_7#6	Holt et al. (2)	ERS011871	<i>pneumoniae</i>	Pus 15007	ERR025574
5197_8#2	Holt et al. (2)	ERS011891	<i>pneumoniae</i>	UI 6717	ERR025583
5197_8#6	Holt et al. (2)	ERS011895	<i>pneumoniae</i>	UI 10871	ERR025587
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5197_7#3	Holt et al. (2)	ERS011868	<i>pneumoniae</i>	Pus 9314/2	ERR025571
5197_8#8	Holt et al. (2)	ERS011897	<i>pneumoniae</i>	ST 752	ERR025589
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5299_7#10	Holt et al. (2)	ERS012055	<i>pneumoniae</i>	TL125	ERR025993
5151_6#9	Holt et al. (2)	ERS011958	<i>pneumoniae</i>	QMP M1-406	ERR025161
5235_2#12	Holt et al. (2)	ERS011997	<i>pneumoniae</i>	QMP M1-418	ERR025608
5235_2#7	Holt et al. (2)	ERS011992	<i>pneumoniae</i>	QMP M1-414	ERR025614
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5151_6#11	Holt et al. (2)	ERS011960	<i>pneumoniae</i>	QMP M1-415	ERR025152
5235_1#9	Holt et al. (2)	ERS011982	<i>pneumoniae</i>	QMP M1-965	ERR025603
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5235_1#8	Holt et al. (2)	ERS011981	<i>pneumoniae</i>	QMP M1-964	ERR025602
5235_2#1	Holt et al. (2)	ERS011986	<i>pneumoniae</i>	QMP M1-972	ERR025605
5235_7#3	Holt et al. (2)	ERS012036	<i>pneumoniae</i>	1557	ERR025662
5299_7#8	Holt et al. (2)	ERS012053	<i>pneumoniae</i>	2033	ERR026000
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5235_7#1	Holt et al. (2)	ERS012034	<i>pneumoniae</i>	1524	ERR025657
5235_8#9	Holt et al. (2)	ERS011791	<i>pneumoniae</i>	09-286G	ERR025680
5235_6#5	Holt et al. (2)	ERS012026	<i>pneumoniae</i>	311G	ERR025651
5193_6#9	Holt et al. (2)	ERS011862	<i>pneumoniae</i>	7085	ERR025525
5193_6#8	Holt et al. (2)	ERS011861	<i>pneumoniae</i>	206535	ERR025524
5193_6#6	Holt et al. (2)	ERS011859	<i>pneumoniae</i>	MM50237	ERR025522
5193_6#5	Holt et al. (2)	ERS011858	<i>pneumoniae</i>	KpV513	ERR025521
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5193_6#12	Holt et al. (2)	ERS011865	<i>pneumoniae</i>	85997	ERR025517
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9263_7#11	Pérez-Vázquez et al. (3)	ERS201951	<i>pneumoniae</i>	K1057	ERR264511
9263_7#12	Pérez-Vázquez et al. (3)	ERS201952	<i>pneumoniae</i>	K1202	ERR264512
9263_7#13	Pérez-Vázquez et al. (3)	ERS201953	<i>pneumoniae</i>	K1232	ERR264513
9263_7#14	Pérez-Vázquez et al. (3)	ERS201954	<i>pneumoniae</i>	K1299	ERR264514
9263_7#15	Pérez-Vázquez et al. (3)	ERS201955	<i>pneumoniae</i>	K1119	ERR264515
9263_7#16	Pérez-Vázquez et al. (3)	ERS201956	<i>pneumoniae</i>	K1288	ERR264516
9263_7#17	Pérez-Vázquez et al. (3)	ERS201957	<i>pneumoniae</i>	K1344	ERR264517
9263_7#18	Pérez-Vázquez et al. (3)	ERS201958	<i>pneumoniae</i>	K754	ERR264518
9263_7#19	Pérez-Vázquez et al. (3)	ERS201959	<i>pneumoniae</i>	K863	ERR264519
9263_7#1	Pérez-Vázquez et al. (3)	ERS201941	<i>pneumoniae</i>	K750	ERR264501
9263_7#20	Pérez-Vázquez et al. (3)	ERS201960	<i>pneumoniae</i>	K943	ERR264520
9263_7#21	Pérez-Vázquez et al. (3)	ERS201961	<i>pneumoniae</i>	K944	ERR264521
9263_7#22	Pérez-Vázquez et al. (3)	ERS201962	<i>pneumoniae</i>	K954	ERR264522
9263_7#23	Pérez-Vázquez et al. (3)	ERS201963	<i>pneumoniae</i>	K966	ERR264523
9263_7#24	Pérez-Vázquez et al. (3)	ERS201964	<i>pneumoniae</i>	K1026	ERR264524
9263_7#25	Pérez-Vázquez et al. (3)	ERS201965	<i>pneumoniae</i>	K864	ERR264525
9263_7#27	Pérez-Vázquez et al. (3)	ERS201967	<i>pneumoniae</i>	K922	ERR264527
9263_7#28	Pérez-Vázquez et al. (3)	ERS201968	<i>pneumoniae</i>	K924	ERR264528
9263_7#29	Pérez-Vázquez et al. (3)	ERS201969	<i>pneumoniae</i>	K953	ERR264529
9263_7#2	Pérez-Vázquez et al. (3)	ERS201942	<i>pneumoniae</i>	K791	ERR264502
9263_7#30	Pérez-Vázquez et al. (3)	ERS201970	<i>pneumoniae</i>	K967	ERR264530
9263_7#31	Pérez-Vázquez et al. (3)	ERS201971	<i>pneumoniae</i>	K1028	ERR264531
9263_7#32	Pérez-Vázquez et al. (3)	ERS201972	<i>pneumoniae</i>	K1029	ERR264532
9263_7#33	Pérez-Vázquez et al. (3)	ERS201973	<i>pneumoniae</i>	K1031	ERR264533

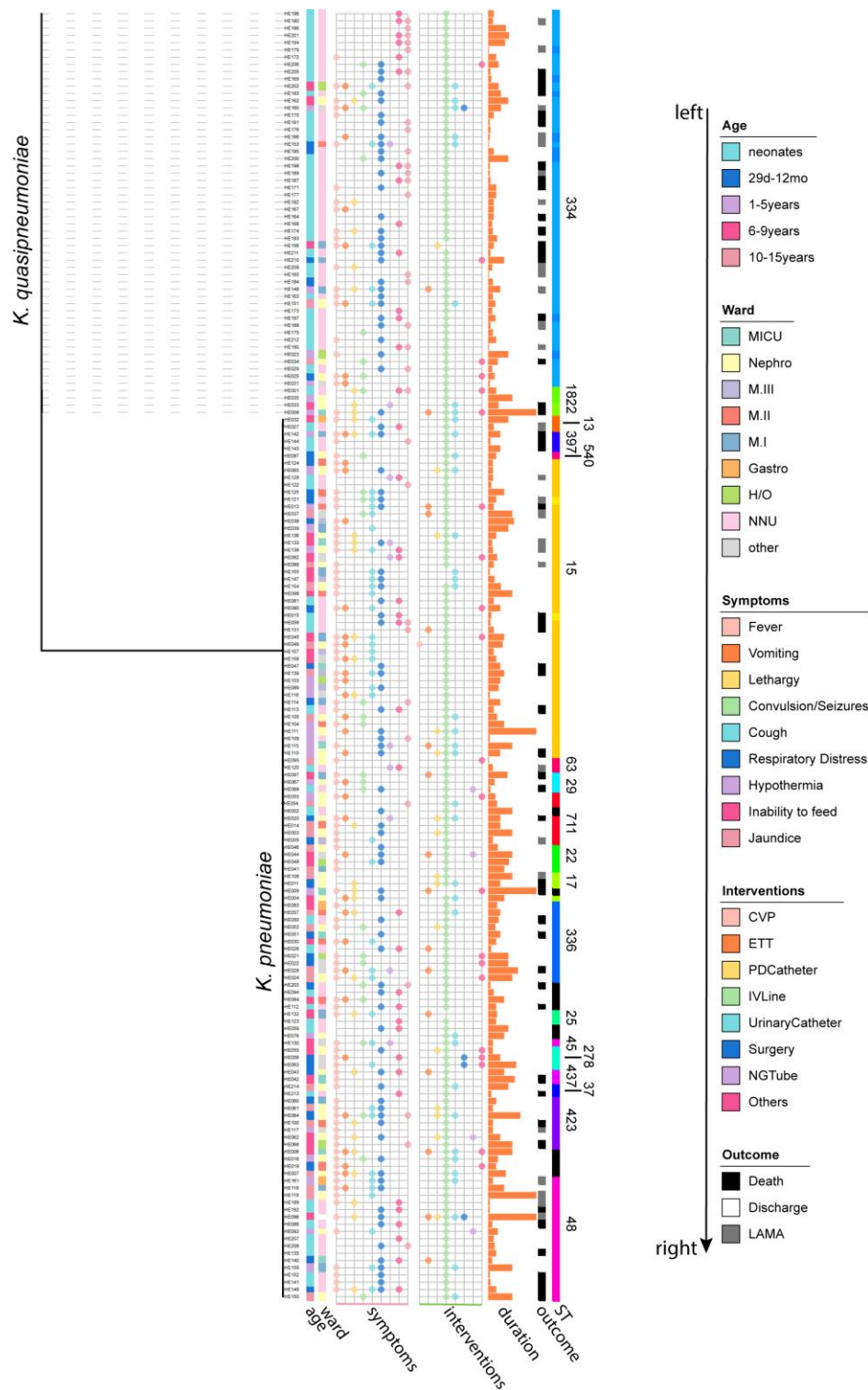
ID	Reference	Sample accession no.	Species	Strain	Accession no.
9263_7#35	Pérez-Vázquez et al. (3)	ERS201975	<i>pneumoniae</i>	K1047	ERR264535
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9263_7#37	Pérez-Vázquez et al. (3)	ERS201977	<i>pneumoniae</i>	K1050	ERR264537
9263_7#38	Pérez-Vázquez et al. (3)	ERS201978	<i>pneumoniae</i>	K1061	ERR264538
9263_7#39	Pérez-Vázquez et al. (3)	ERS201979	<i>pneumoniae</i>	K1063	ERR264539
9263_7#3	Pérez-Vázquez et al. (3)	ERS201943	<i>pneumoniae</i>	K792	ERR264503
9263_7#40	Pérez-Vázquez et al. (3)	ERS201980	<i>pneumoniae</i>	K1064	ERR264540
9263_7#41	Pérez-Vázquez et al. (3)	ERS201981	<i>pneumoniae</i>	K1065	ERR264541
9263_7#42	Pérez-Vázquez et al. (3)	ERS201982	<i>pneumoniae</i>	K1069	ERR264542
9263_7#43	Pérez-Vázquez et al. (3)	ERS201983	<i>pneumoniae</i>	K1070	ERR264543
9263_7#44	Pérez-Vázquez et al. (3)	ERS201984	<i>pneumoniae</i>	K1071	ERR264544
9263_7#45	Pérez-Vázquez et al. (3)	ERS201985	<i>pneumoniae</i>	K1072	ERR264545
9263_7#46	Pérez-Vázquez et al. (3)	ERS201986	<i>pneumoniae</i>	K1073	ERR264546
9263_7#47	Pérez-Vázquez et al. (3)	ERS201987	<i>pneumoniae</i>	K1074	ERR264547
9263_7#48	Pérez-Vázquez et al. (3)	ERS201988	<i>pneumoniae</i>	K725	ERR264548
9263_7#49	Pérez-Vázquez et al. (3)	ERS201989	<i>pneumoniae</i>	K727	ERR264549
9263_7#4	Pérez-Vázquez et al. (3)	ERS201944	<i>pneumoniae</i>	K946	ERR264504
9263_7#50	Pérez-Vázquez et al. (3)	ERS201990	<i>pneumoniae</i>	K726	ERR264550
9263_7#51	Pérez-Vázquez et al. (3)	ERS201991	<i>pneumoniae</i>	K730	ERR264551
9263_7#52	Pérez-Vázquez et al. (3)	ERS201992	<i>pneumoniae</i>	K757	ERR264552
9263_7#53	Pérez-Vázquez et al. (3)	ERS201993	<i>pneumoniae</i>	K758	ERR264553
9263_7#54	Pérez-Vázquez et al. (3)	ERS201994	<i>pneumoniae</i>	K760	ERR264554
9263_7#55	Pérez-Vázquez et al. (3)	ERS201995	<i>pneumoniae</i>	K761	ERR264555
9263_7#56	Pérez-Vázquez et al. (3)	ERS201996	<i>pneumoniae</i>	K763	ERR264556
9263_7#57	Pérez-Vázquez et al. (3)	ERS201997	<i>pneumoniae</i>	K796	ERR264557
9263_7#58	Pérez-Vázquez et al. (3)	ERS201998	<i>pneumoniae</i>	K810	ERR264558
9263_7#59	Pérez-Vázquez et al. (3)	ERS201999	<i>pneumoniae</i>	K811	ERR264559
9263_7#5	Pérez-Vázquez et al. (3)	ERS201945	<i>pneumoniae</i>	K804	ERR264505
9263_7#60	Pérez-Vázquez et al. (3)	ERS202000	<i>pneumoniae</i>	K893	ERR264560
9263_7#61	Pérez-Vázquez et al. (3)	ERS202001	<i>pneumoniae</i>	K870	ERR264561
9263_7#62	Pérez-Vázquez et al. (3)	ERS202002	<i>pneumoniae</i>	K871	ERR264562
9263_7#63	Pérez-Vázquez et al. (3)	ERS202003	<i>pneumoniae</i>	K874	ERR264563
9263_7#64	Pérez-Vázquez et al. (3)	ERS202004	<i>pneumoniae</i>	K875	ERR264564
9263_7#65	Pérez-Vázquez et al. (3)	ERS202005	<i>pneumoniae</i>	K879	ERR264565
9263_7#66	Pérez-Vázquez et al. (3)	ERS202006	<i>pneumoniae</i>	K892	ERR264566
9263_7#67	Pérez-Vázquez et al. (3)	ERS202007	<i>pneumoniae</i>	K925	ERR264567
9263_7#68	Pérez-Vázquez et al. (3)	ERS202008	<i>pneumoniae</i>	K935	ERR264568
9263_7#69	Pérez-Vázquez et al. (3)	ERS202009	<i>pneumoniae</i>	K756	ERR264569
9263_7#6	Pérez-Vázquez et al. (3)	ERS201946	<i>pneumoniae</i>	K983	ERR264506
9263_7#70	Pérez-Vázquez et al. (3)	ERS202010	<i>pneumoniae</i>	K809	ERR264570
9263_7#71	Pérez-Vázquez et al. (3)	ERS202011	<i>pneumoniae</i>	K891	ERR264571
9263_7#72	Pérez-Vázquez et al. (3)	ERS202012	<i>pneumoniae</i>	K889	ERR264572
9263_7#73	Pérez-Vázquez et al. (3)	ERS202013	<i>pneumoniae</i>	K876	ERR264573
9263_7#74	Pérez-Vázquez et al. (3)	ERS202014	<i>pneumoniae</i>	K877	ERR264574
9263_7#75	Pérez-Vázquez et al. (3)	ERS202015	<i>pneumoniae</i>	K881	ERR264575
9263_7#76	Pérez-Vázquez et al. (3)	ERS202016	<i>pneumoniae</i>	K882	ERR264576
9263_7#77	Pérez-Vázquez et al. (3)	ERS202017	<i>pneumoniae</i>	K884	ERR264577
9263_7#7	Pérez-Vázquez et al. (3)	ERS201947	<i>pneumoniae</i>	K779	ERR264507
9263_7#8	Pérez-Vázquez et al. (3)	ERS201948	<i>pneumoniae</i>	K956	ERR264508
9263_7#9	Pérez-Vázquez et al. (3)	ERS201949	<i>pneumoniae</i>	K1035	ERR264509
9517_7#10	Pérez-Vázquez et al. (3)	ERS213445	<i>pneumoniae</i>	K1257	ERR298797
9517_7#11	Pérez-Vázquez et al. (3)	ERS213446	<i>pneumoniae</i>	K1108	ERR298798
9517_7#12	Pérez-Vázquez et al. (3)	ERS213447	<i>pneumoniae</i>	K1286	ERR298799
9517_7#13	Pérez-Vázquez et al. (3)	ERS213448	<i>pneumoniae</i>	K1287	ERR298800
9517_7#14	Pérez-Vázquez et al. (3)	ERS213449	<i>pneumoniae</i>	K1367	ERR298801
9517_7#15	Pérez-Vázquez et al. (3)	ERS213450	<i>pneumoniae</i>	K1387	ERR298802
9517_7#16	Pérez-Vázquez et al. (3)	ERS213451	<i>pneumoniae</i>	K1388	ERR298803
9517_7#17	Pérez-Vázquez et al. (3)	ERS213452	<i>pneumoniae</i>	K1363	ERR298804
9517_7#18	Pérez-Vázquez et al. (3)	ERS213453	<i>pneumoniae</i>	K1667	ERR298805
9517_7#19	Pérez-Vázquez et al. (3)	ERS213454	<i>pneumoniae</i>	K1668	ERR298806
9517_7#1	Pérez-Vázquez et al. (3)	ERS213436	<i>pneumoniae</i>	K830	ERR298788
9517_7#20	Pérez-Vázquez et al. (3)	ERS213455	<i>pneumoniae</i>	K1518	ERR298807
9517_7#21	Pérez-Vázquez et al. (3)	ERS213456	<i>pneumoniae</i>	K1579	ERR298808
9517_7#22	Pérez-Vázquez et al. (3)	ERS213457	<i>pneumoniae</i>	K1603	ERR298809
9517_7#23	Pérez-Vázquez et al. (3)	ERS213458	<i>pneumoniae</i>	K1539	ERR298810
9517_7#24	Pérez-Vázquez et al. (3)	ERS213459	<i>pneumoniae</i>	K1471	ERR298811
9517_7#25	Pérez-Vázquez et al. (3)	ERS213460	<i>pneumoniae</i>	K1641	ERR298812
9517_7#26	Pérez-Vázquez et al. (3)	ERS213461	<i>pneumoniae</i>	K1624	ERR298813

ID	Reference	Sample accession no.	Species	Strain	Accession no.
9517_7#27	Pérez-Vázquez et al. (3)	ERS213462	<i>pneumoniae</i>	K1623	ERR298814
9517_7#28	Pérez-Vázquez et al. (3)	ERS213463	<i>pneumoniae</i>	K1620	ERR298815
9517_7#2	Pérez-Vázquez et al. (3)	ERS213437	<i>pneumoniae</i>	K1075	ERR298789
9517_7#3	Pérez-Vázquez et al. (3)	ERS213438	<i>pneumoniae</i>	K1115	ERR298790
9517_7#4	Pérez-Vázquez et al. (3)	ERS213439	<i>pneumoniae</i>	K997	ERR298791
9517_7#5	Pérez-Vázquez et al. (3)	ERS213440	<i>pneumoniae</i>	K1004	ERR298792
9517_7#7	Pérez-Vázquez et al. (3)	ERS213442	<i>pneumoniae</i>	K1144	ERR298794
9517_7#8	Pérez-Vázquez et al. (3)	ERS213443	<i>pneumoniae</i>	K1148	ERR298795
9517_7#9	Pérez-Vázquez et al. (3)	ERS213444	<i>pneumoniae</i>	K1186	ERR298796
5235_2#4	Holt et al. (2)	ERS011989	<i>quasipneum</i>	QMP M1-977	ERR025611
5151_2#9	Holt et al. (2)	ERS011922	<i>quasipneum</i>	DR85/08	ERR025122
5193_3#1	Holt et al. (2)	ERS011830	<i>quasipneum</i>	K268An	ERR025488
5193_2#10	Holt et al. (2)	ERS011815	<i>quasipneum</i>	K38An	ERR025476
5197_2#12	Holt et al. (2)	ERS011829	<i>quasipneum</i>	K263An	ERR025556
5193_3#11	Holt et al. (2)	ERS011840	<i>quasipneum</i>	C-017-l-a-1	ERR025490
5193_5#4	Holt et al. (2)	ERS011845	<i>quasipneum</i>	033-CAZ-1	ERR025507
5193_5#6	Holt et al. (2)	ERS011847	<i>quasipneum</i>	073-CN-2	ERR025509
5193_6#1	Holt et al. (2)	ERS011854	<i>quasipneum</i>	EW-60-R-MAG-2	ERR025514
5197_2#5	Holt et al. (2)	ERS011822	<i>quasipneum</i>	K222Ca	ERR025560
5197_2#4	Holt et al. (2)	ERS011821	<i>quasipneum</i>	K215Ax	ERR025559
5193_2#3	Holt et al. (2)	ERS011808	<i>quasipneum</i>	NCSR130	ERR025480
5193_2#4	Holt et al. (2)	ERS011809	<i>quasipneum</i>	BAL073	ERR025481
5193_8#9	Holt et al. (2)	ERS011910	<i>quasipneum</i>	DU35427/05	ERR025551
5150_2#1	Holt et al. (2)	ERS005752	<i>quasipneum</i>	AJ055	ERR024830
5193_7#10	Holt et al. (2)	ERS011887	<i>quasipneum</i>	UI 4256	ERR025528
5193_7#8	Holt et al. (2)	ERS011885	<i>quasipneum</i>	UI 2877	ERR025537
5197_8#5	Holt et al. (2)	ERS011894	<i>quasipneum</i>	UI 9552	ERR025586
5197_8#3	Holt et al. (2)	ERS011892	<i>quasipneum</i>	UI 7631	ERR025584
5151_2#12	Holt et al. (2)	ERS011925	<i>variicola</i>	QMP B2-481	ERR025114
5193_8#7	Holt et al. (2)	ERS011908	<i>variicola</i>	QMP B2-288	ERR025549
5151_2#7	Holt et al. (2)	ERS011920	<i>variicola</i>	QMP B2-340	ERR025120
5151_3#1	Holt et al. (2)	ERS011926	<i>variicola</i>	QMP B2-483	ERR025124
5151_5#10	Holt et al. (2)	ERS011947	<i>variicola</i>	QMP M1-765	ERR025138
5151_5#9	Holt et al. (2)	ERS011946	<i>variicola</i>	QMP M1-763	ERR025148
5151_6#12	Holt et al. (2)	ERS011961	<i>variicola</i>	QMP M1-428	ERR025153
5151_5#6	Holt et al. (2)	ERS011943	<i>variicola</i>	QMP M1-726	ERR025145
5299_1#12	Holt et al. (2)	ERS011973	<i>variicola</i>	QMP M1-888	ERR025982
5235_1#4	Holt et al. (2)	ERS011977	<i>variicola</i>	QMP M1-893	ERR025598
5197_7#5	Holt et al. (2)	ERS011870	<i>variicola</i>	Pus 13542	ERR025573
5235_8#10	Holt et al. (2)	ERS011792	<i>variicola</i>	08-109P	ERR025671
5193_1#10	Holt et al. (2)	ERS011803	<i>variicola</i>	1892m	ERR025463
5150_1#7	Holt et al. (2)	ERS005747	<i>variicola</i>	AJ026	ERR024826
5150_3#8	Holt et al. (2)	ERS005771	<i>variicola</i>	AJ182	ERR024853
5150_1#8	Holt et al. (2)	ERS005748	<i>variicola</i>	AJ027	ERR024827
5150_2#2	Holt et al. (2)	ERS005754	<i>variicola</i>	AJ135	ERR024834
5150_5#2	Holt et al. (2)	ERS005778	<i>variicola</i>	AJ292	ERR025102
5235_5#1	Holt et al. (2)	ERS012010	<i>quasipneum</i>	QMP Z4-726	ERR025631



Technical Appendix Figure 1. Whole-genome clustering. Cluster analysis using mash (4) for the rapid identification of species was used to identify putative members of KpI (*Klebsiella pneumoniae*), KpII (*K. quasipneumoniae*) and KpIII (*K. variicola*) by comparison of several reference strains and the global collection ([2] blue bar) with the isolates from this study (yellow bar). In-depth analysis indicates a large

diversity within KpI (B) and a large group of highly similar members of KpII (C), most similar to the reference *K. quasipneumoniae* subsp. *similipneumoniae* (in other literature also referred to as KpIIA).



Technical Appendix Figure 2. Patient metadata in phylogenetic context. The guidance tree is based on the core gene alignment for this strain set generated by roary. The metadata are shown as depicted in the legends, Intravenous lines (cannulas) were used to administer dextrose saline, mannitol and antimicrobial drugs if oral treatment was not possible. STs with <3 members are shown in black; shading within a

sequence type (e.g., bright and dark yellow for ST15) indicates uncertain predictions (e.g., ST15~). CVP, central venous pressure (line); ETT, endotracheal tube; gastro, gastroenterology; H/O, hematology oncology; IV, intravenous; LAMA, left against medical advice; M, medical unit; MICU, medical intensive care unit; NG, nasogastric; NNU, neonatal nursery; ST, sequence type.

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