Names for KEL (ISBT 006) Blood Group Alleles

Intro

General description:	The Kell blood group system consists of 36 antigens carried on a type II transmembrane glycoprotein (aka CD238) of 732 amino acids. The Kell glycoprotein is a zinc-dependent metalloproteinase that has been shown to have endothelin-3-converting enzyme activity. A single disulfide bond (Kell Cys72 - XK Cys347) links the KEL protein to the XK membrane protein that carries the Kx antigen. Absence of XK leads to a reduction of expression of Kell antigens on the red blood cell membrane.
Gene name:	*KEL*
Number of exons:	19
Initiation codon:	Within exon 1
Stop codon:	Within exon 19
Entrez Gene ID:	3792
LRG:	LRG_799
LRG sequence:	NG_007492.2 (genomic) NM_000420.2 (transcript) NP_000411.1 (protein)
Reference allele:	*KEL*02* (shaded) Acceptable: *k* if inferred by haemagglutination
Reference allele *KEL*02* encodes:	KEL2, KEL4, KEL5, KEL7, KEL11, KEL12, KEL13, KEL14, KEL16, KEL18, KEL19, KEL20, KEL22, KEL26, KEL27, KEL29, KEL30, KEL32, KEL33, KEL34, KEL35, KEL36, KEL37, KEL38
Antithetical antigens:	[KEL1 KEL2]; [KEL3 KEL4 KEL21]; [KEL6 KEL7]; [KEL11 KEL17]; [KEL14 KEL24]; [KEL31 KEL38]; [KEL37 KEL39]
Low frequency antigens:	KEL3, KEL6, KEL10, KEL17, KEL21, KEL23, KEL24, KEL25, KEL28, KEL31, KEL39

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon	Predicted amino acid change	(Reference nr) PMID	Accession number	rs number
KEL:1,-2 or K+k-	*KEL*01.01*	c.578C>T	6	p.Thr193Met	(1), PMID: 7849312	S76770.1	rs8176058
KEL:1weak or K+w	*KEL*01.02*	c.577A>T	6	p.Thr193Ser	(2), PMID: 17076841	n.a.	rs61729031
KEL:1weak,3 or K+w, Kp(a+)	*KEL*01.03*	c.578C>T c.841C>T	6 8	p.Thr193Met p.Arg281Trp	(3), PMID: 19347978	FM208212.1	rs8176058 rs8176059
KEL:2 or k+	*KEL*02*	c.578C	6	p.Thr193	(4), PMID: 1712490	M64934 NM_000420.2	rs8176058
KEL:3,-4,-21 or Kp(a+b–c–)	*KEL*02.03*	c.841C>T	8	p.Arg281Trp	(5), PMID: 8669078	AM085119	rs8176059
KEL:6,-7 or Js(a+b–)	*KEL*02.06*	c.1790T>C	17	p.Leu597Pro	(6), PMID: 7570911	S80081.1	rs8176038
KEL:10 or Ul(a+)	*KEL*02.10*	c.1481A>T	13	p.Glu494Val	(5), PMID: 8669078	n.a.	rs61729032
KEL: -12	*KEL*02.-12*	c.1643A>G	15	p.His548Arg	(7), PMID: 9426633	n.a.	rs61729033
KEL:-14,-24	*KEL*02.-14.1*	c.538C>T	6	p.Arg180Cys	(8), PMID: 9354821	n.a.	rs747437444
KEL:-14	*KEL*02.-14.2*	c.539G>A	6	p.Arg180His	(8), PMID: 9354821	n.a.	rs61729039
KEL: -11,17	*KEL*02.17*	c.905T>C	8	p.Val302Ala	(5), PMID: 8669078	n.a.	rs61729034
KEL:-18	*KEL*02.-18.1*	c.388C>T	4	p.Arg130Trp	(7), PMID: 9426633	n.a.	rs184131044
KEL:-18	*KEL*02.-18.2*	c.389G>A	4	p.Arg130Gln	(7), PMID: 9426633	n.a.	rs201110152
KEL:-19	*KEL*02.-19*	c.1475G>A	13	p.Arg492Gln	(7), PMID: 9426633	n.a.	rs61729035
KEL:-3,-4,21 or Kp(a–b–c+)	*KEL*02.21*	c.842G>A	8	p.Arg281Gln	(5), PMID: 8669078	n.a.	rs61729036
KEL:-22	*KEL*02.-22*	c.965C>T	9	p.Ala322Val	(7), PMID: 9426633	n.a.	rs61729037
KEL:23	*KEL*02.23*	c.1145A>G	10	p.Gln382Arg	(9), PMID: 9269063	n.a.	rs61729038
KEL: -14,24	*KEL*02.24*	c.539G>C	6	p.Arg180Pro	(8), PMID: 9354821	n.a.	rs61729039
KEL:25,-28 or VLAN+ VONG-	*KEL*02.25*	c.743G>A	8	p.Arg248Gln	(10), PMID: 8837356	n.a.	rs61729040

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon	Predicted amino acid change	(Reference nr) PMID	Accession number	rs number
KEL:-26 or TOU-	*KEL*02.-26*	c.1217G>A	11	p.Arg406Gln	(7), PMID: 9426633	n.a.	rs61729041
KEL:-27 or RAZ-	*KEL*02.-27*	c.745G>A	8	p.Glu249Lys	(11), PMID: 11904003	n.a.	rs61729042
KEL:-25,28 or VLAN- VONG+	*KEL*02.28*	c.742C>T	8	p.Arg248Trp	(12), Abstract	n.a.	rs61728832
KEL:-29 or KALT-	*KEL*02.-29*	c.1868G>A	17	p.Arg623Lys	(13), PMID: 16934067	JN038574.1	rs61729043
KEL:−30 or KTIM-	*KEL*02.-30*	c.913G>A	8	p.Asp305Asn	(13), PMID: 16934067	JN038575.1	rs61729044
KEL:31, -38 or KYO+, KYOR-	*KEL*02.31*	c.875G>A	8	p.Arg292Gln	(14), Abstract (15), PMID: 23968329	n.a.	rs201698610
KEL:-32 or KUCI-	*KEL*02.-32*	c.1271C>T	11	p.Ala424Val	(16), PMID: 23560718	JN020633.1	rs779011501
KEL:-33 or KANT-	*KEL*02.-33*	c.1283G>T	11	p.Arg428Leu	(16), PMID: 23560718	JN038573.1	rs750806448
KEL:-34 or KASH-	*KEL*02.-34*	c.758A>G	8	p.Tyr253Cys	(17), Abstract	n.a.	n.a.
KEL:-35 or KELP-	*KEL*02.-35*	c.780G>T c.2024G>A	8 18	p.Leu260Phe p.Arg675Gln	(18), Abstract	n.a.	rs1235779167 rs760716472
KEL:-36 or KETI-	*KEL*02.-36*	c.1391C>T	12	p.Thr464Ile	(19), Abstract	n.a.	rs190890637
KEL:-37,39 or KHUL-,KEAL+	*KEL*02.39*	c.877C>T	8	p.Arg293Trp	(15), PMID: 23968329 (20), PMID: 27679424	KF366655.1	rs557358978
KEL:40 (*published as KEL*02.38*)	*KEL*02.40 (only silent mutations)*	c.1546C>A	14	p.Arg516Arg	(21), PMID: 24845979	HG512887.1	rs8176034
Null Phenotypes							
K_0	*KEL*01N.01*	c.578C>T c.1678C>G	15	p.Thr193Met p.Pro560Ala	(22), PMID: 25960716	n.a.	rs8176058 rs61729046
K_0	*KEL*01N.02*	c.244T>C c.578C>T]	4 6	p.Cys82Arg p.Thr193Met	(23), PMID: 23581548	n.a.	rs369127636 rs8176058
K_0	*KEL*01N.03*	c.1382_1385del4	12	p.Asn461Argfs*25	(48), PMID: 27861976	KX431940.1	n.a.

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon	Predicted amino acid change	(Reference nr) PMID	Accession number	rs number
K_0	*KEL*02N.01*	c.223+1g>c	Intron 3	Aberrant splicing: p.Ser28AlafsTer113	(24), PMID: 11134029	n.a.	rs369569464
K_0	*KEL*02N.02 (See also KEL*02N.26)*	c.382C>T c.1790T>C	4 17	p.Arg128* p.Leu597Pro	(25), PMID: 11375401	n.a.	rs61729053 rs8176038
K_0	*KEL*02N.03*	c.246T>A	4	p.Cys82*	(25), PMID: 11375401	n.a.	rs61729058
K_0	*KEL*02N.04*	c.1042C>T	9	p.Gln348*	(25), PMID: 11375401 (28), PMID: 17381630	AM085122.1	rs61729054
K_0	*KEL*02N.05*	c.2027G>A	18	p.Ser676Asn	(25), PMID: 11375401	n.a.	rs61729051
K_0	*KEL*02N.06*	c.223+1g>a	Intron 3	Aberrant splicing: p.Ser28AlafsTer113	(25), PMID: 11375401 (28), PMID: 17381630	AM085124.1	rs369569464
K_0	*KEL*02N.07*	c.574C>T	6	p.Arg192*	(25), PMID: 11375401	n.a.	rs200430183
K_0	*KEL*02N.08*	c.526-2a>g	Intron 5	Aberrant splicing: p.Leu176Alafs*9	(26), PMID: 11918559	n.a.	n.a.
K_0	*KEL*02N.09*	c.1377G>A	12	p.Trp459*	(26), PMID: 11918559	n.a.	rs61729052
K_0	*KEL*02N.10*	c.1420C>T	13	p.Gln474*	(27), PMID: 15819675	DQ340982.1	rs61729056
K_0	*KEL*02N.11*	c.904delG	8	p.Val302Serfs*28	(27), PMID: 15819675	DQ340981.1	rs61729059
K_0	*KEL*02N.12*	c.924+1g>a	Intron 8	Aberrant splicing	(28), PMID: 17381630	AM085117.1	rs568600999
K_0	*KEL*02N.13*	c.924+1g>t	Intron 8	Aberrant splicing	(28), PMID: 17381630	AM085127.1	rs568600999
K_0	*KEL*02N.14*	c.948G>A	9	p.Trp316*	(28), PMID: 17381630	AM085128.1	rs61729049
K_0	*KEL*02N.15*	c.1216C>T	11	p.Arg406*	(28), PMID: 17381630	AM085114.1	rs61729045
K_0	*KEL*02N.16*	c.1477C>T	13	p.Gln493*	(28), PMID: 17381630	AM085125.1	rs61729050
K_0	*KEL*02N.17*	c.1546C>T	14	p.Arg516*	(28), PMID: 17381630	AM085126.1 AM183930.1	rs8176034
K_0	*KEL*02N.18*	c.1678C>G	15	p.Pro560Ala	(28), PMID: 17381630	AM085120.1	rs61729046

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon	Predicted amino acid change	(Reference nr) PMID	Accession number	rs number
K_0	*KEL*02N.19*	c.2023C>T	18	p.Arg675*	(28), PMID: 17381630	AM085118.1	rs61729047
K_0	*KEL*02N.20*	c.1596G>A	15	p.Trp532*	(29), PMID: 12869119	n.a.	n.a.
K_0	*KEL*02N.21*	c.1947C>G	18	p.Tyr649*	(30), Book	n.a.	rs902425813
K_0	*KEL*02N.22*	c.736−1g>c	Intron 7	Aberrant splicing	(31), PMID: 20384970	bankit1316809	rs765075509
K_0	*KEL*02N*.23	c.184dupT (*published as 185insT*)	3	p.Ser62Phefs*17	(32), PMID: 19747286	EF208900.1	rs751207765
K_0	*KEL*02N.24*	c.715G>T	7	p.Glu239*	(32), PMID: 19747286	EF208901.1	rs766427535
K_0	*KEL*02N.25*	c.1975delG	18	p.Glu659Argfs*22	(23), PMID: 23581548	n.a.	rs1042359399
K_0	*KEL*02N.26 (See also KEL*02N.02)*	c.382C>T	4	p.Arg128*	(23), PMID: 23581548	n.a.	rs61729053
K_0	*KEL*02N.27*	c.730delG	7	p.Ala244Profs*8	(33), PMID: 21707797	n.a.	n.a.
K_0	*KEL*02N.28*	c.230G>T	4	p.Cys77Phe	(15), PMID: 23968329	KF280266.1	n.a.
K_0	*KEL*02N.29*	c.1664G>A	15	p.Gly555Glu	(15), PMID: 23968329	KF366656.1	n.a.
K_0	*KEL*02N.30*	c.71G>A	2	p.Trp24*	(34), PMID: 24506314	n.a.	rs753369164
K_0	*KEL*02N.31*	c.1771+1g>a	Intron 16	Aberrant splicing	(34), PMID: 24506314	n.a.	rs869025768
K_0	*KEL*02N.32*	c.455A>G	5	p.Tyr152Cys	(35), PMID: 25041236	n.a.	rs1228818924
K_0	*KEL*02N.33*	c.1726G>C	16	p.Gly576Arg	(35), PMID: 25041236	n.a.	rs201778033
K_0	*KEL*02N.34*	c.841C>T c.2099G>A	8 19	p.Arg281Trp p.Arg700Gln	(21), PMID: 24845979	HG512886.1	rs8176059 rs1268359042
K_0	*KEL*02N.35*	c.398T>C	4	p.Leu133Pro	(36), PMID: 25156717	KF993652.1	n.a.
K_0	*KEL*02N.36*	c.436delG	5	p.Glu146Argfs*43	(36), PMID: 25156717	KJ636457.1	rs762799244

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon	Predicted amino acid change	(Reference nr) PMID	Accession number	rs number
K_0	*KEL*02N.37*	c.1253T>C	11	p.Phe418Ser	(36), PMID: 25156717	KF993653.1	rs149225200
K_0	*KEL*02N.38*	c.1832T>G	17	p.Leu611Arg	(36), PMID: 25156717	KJ636456.1	n.a.
K_0	*KEL*02N.39*	c.2098C>T	19	p.Arg700*	(36), PMID: 25156717	KF993655.1	rs565926203
K_0	*KEL*02N.40*	c.1474C>T	13	p.Arg492*	(36), PMID: 25156717	KF993654.1	rs932456335
K_0	*KEL*02N.41*	c.267C>G	4	p.Tyr89*	(46), PMID: 27888518	n.a.	rs879327552
K_0	*KEL*02N.42*	c.299G>C	4	p.C100S	(47), PMID: 29280152	LC314159.1	rs 200268316
K_0	*KEL*02N.43*	c.328delA	4	p.R110Gfs*79	(47), PMID: 29280152	LC314160.1	n.a.
K_0	*KEL*02N.44*	c.2175delC	19	p.S726Pfs*43	(47), PMID: 29280152	LC314161.1	rs773975756
K_0	*KEL*02N.45*	c.937G>A c.1073G>C	9	p.A313T p.R358T possibly aberrant splicing	(47), PMID: 29280152	LC314162.1	rs191311545 n.a.
K_0	*KEL*02N.46*	c.160_161delATinsCTCC	3	p.I54Lfs*136	(47), PMID: 29280152	LC314163.1	n.a.
K_0	*KEL*02N.47 (See KEL*02M.18)*	c.1664G>T	15	p.Gly555Val	(47), PMID: 29280152	LC314164.1	n.a.
K_0	*KEL*02N.48*	c.481A>T	5	p.I161F	(47), PMID: 29280152	LC314165.1	n.a.
K_0	*KEL*02N.49*	c.997C>T	9	p.Q333*	(47), PMID: 29280152	LC314166.1	n.a.
K_0	*KEL*02N.50*	c.2120delG	19	p.S707Tfs*17	(47), PMID: 29280152	LC314167.1	n.a.
K_0	*KEL*02N.51*	c.1414-1G>C	Intron 12	Aberrant splicing	(47), PMID: 29280152	LC314168.1	rs906814829
K_0	*KEL*02N.52*	c.1813_1814insC	17	p.Q605Pfs*18	(47), PMID: 29280152	LC314169.1	n.a.
K_0	*KEL*02N.53*	c.371delA	4	p.Lys124Argfs*65	(48), PMID: 27861976	KX431939.1	n.a.
K_0	*KEL*02N.54*	c.201C>A	3	p.Tyr67*	(48), PMID: 27861976	KX431938.1	n.a.

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon	Predicted amino acid change	(Reference nr) PMID	Accession number	rs number
Mod phenotypes (weak expression KEL antigens) Classification of a mod phenotype may depend on the reagents used							
Kmod or KEL:1weak	*KEL*01M.01*	c.578C>G	6	p.Thr193Arg	(37), Abstract	n.a.	rs8176058
Kmod	*KEL*01M.02*	c.578C>T c.977C>T	6 9	p.Thr193Met p.Pro326Leu	(38), PMID: 24588083	HG514448.1	rs8176058, rs751284993
Kmod	*KEL*01M.03*	c.578C>T c.1339C>T c.1680A>C	6 12 15	p.Thr193Met p.Arg447Trp p.Pro560Pro	(39), PMID: 26996808	LN899832.1	rs8176058 rs142604829 rs8176036
Kmod	*KEL*01M.04*	c.578C>T c.1920G>C c.1921G>A	6 17 17	p.Thr193Met p.Gly640Gly p.Gly641Arg	(39), PMID: 26996808	LN899833.1	rs8176058 n.a. rs542976466
Kmod	*KEL*01M.05*	c.578C>T c.1899A>G c.1934C>T	6 17 17	p.Thr193Met p.Leu633Leu p.Ala645Val	(39), PMID: 26996808	LN899834.1 LN680548	rs8176058 rs8176039 rs147851584
Kmod	*KEL*01M.06*	c.578C>T c.1680A>C c.2107G>C	6 15 19	p.Thr193Met p.Pro560Pro p.Gly703Arg	(39), PMID: 26996808	LN899835.1	rs8176058 rs8176036 rs191330570
Kmod	*KEL*02M.01*	c.1088G>A	10	p.Ser363Asn	(25), PMID: 11375401 (29), PMID: 12869119	n.a.	rs61729055
Kmod	*KEL*02M.02*	c.2030A>G	18	p.Tyr677Cys	(29), PMID: 12869119	AM085116.1	rs147464117
Kmod KEL:−13	*KEL*02M.03*	c.986T>C	9	p.Leu329Pro	(29), PMID: 12869119	n.a.	rs61729057
Kmod	*KEL*02M.04*	c.2107G>A	19	p.Gly703Arg	(29), PMID: 12869119	n.a.	rs191330570
K_0 phenotype	*KEL*02M.05 (Only silent mutation)*	c.1719C>T	16	p.Gly573Gly	(40), PMID: 24795954	AM085115.1 KC922434.1	rs145850557
Kmod	*KEL*02M.06*	c.306C>A c.1298C>T	4 11	p.Asp102Glu p.Pro433Leu	(28), PMID: 17381630	AM085123.1	rs758637202 rs143238294
Kmod	*KEL*02M.07*	c.1763A>G	16	p.Tyr588Cys	(28), PMID: 17381630	AM085121.1	rs61729048

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon	Predicted amino acid change	(Reference nr) PMID	Accession number	rs number
Kmod	*KEL*02M.08*	c.1490A>T	13	p.Asp497Val	(41), Abstract	AM183929.1	rs1286534156
Kmod	*KEL*02M.09*	c.1757T>G	16	p.Ile586Ser	(42), Book	n.a.	n.a.
Kmod	*KEL*02M.10*	c.787G>A	8	p.Gly263Arg	(31), PMID: 20384970	EU362929	n.a.
Kmod	*KEL*02M.11*	c.1268C>T	11	p.Ala423Val	(9), PMID: 9269063	n.a.	rs61728831
Kmod	*KEL*02M.12*	c.2111C>A	19	p.Pro704His	(35), PMID: 25041236	FM208265	rs747806266
Kmod	*KEL*02M.13*	c.257G>A c.841C>T	4 8	p.Arg86Gln p.Arg281Trp	(36), PMID: 25156717	KF993651.1 AM183928.1	rs777011308 rs8176059
Kmod	*KEL*02M.14*	c.1084C>A	10	p.Gln362Lys	(43), PMID: 23581578	n.a.	rs766310210
Kmod	*KEL*02M.15*	c.575G>C	6	p.Arg192Pro	(39), PMID: 26996808	LN899836.1	rs754663945
Kmod	*KEL*02M.16*	c.788G>A	8	p.Gly263Glu	(39), PMID: 26996808	LN899837.1	rs775889759
Kmod	*KEL*02M.17*	c.586C>G	6	p.Leu196Val	(44), PMID: 30586164	MH136803.1	rs760539605
Kmod	*KEL*02M.18 (See KEL*02N.47)*	c.1664G>T	15	p.Gly555Val	(45), PMID: 31077392	LC440557.1	n.a.

Nucleotide 1 is the first nucleotide of the translation-initiating codon, which is 120 bp downstream of the traditional position for the first nucleotide of early reports.

References

1. PMID: 7849312 — Lee S, Wu X, Reid M, et al.: Molecular basis of the Kell (K1) phenotype. *Blood* 1995; 85: 912-6.

2. PMID: 17076841 — Poole J, Warke N, Hustinx H, et al.: A KEL gene encoding serine at position 193 of the Kell glycoprotein results in expression of KEL1 antigen. *Transfusion* 2006; 46: 1879-85.

3. PMID: 19347978 — Körmöczi GF, Scharberg EA, Gassner C: A novel KEL*1,3 allele with weak Kell antigen expression confirming the cis-modifier effect of KEL3. *Transfusion* 2009; 49: 733-9.

4. PMID: 1712490 — Lee S, Zambas ED, Marsh WL, et al.: Molecular cloning and primary structure of Kell blood group protein. *Proc Natl Acad Sci U S A* 1991; 88: 6353-7.

5. PMID: 8669078 — Lee S, Wu X, Son S, et al.: Point mutations characterize KEL10, the KEL3, KEL4, and KEL21 alleles, and the KEL17 and KEL11 alleles. *Transfusion* 1996; 36: 490-4.

6. PMID: 7570911 — Lee S, Wu X, Reid M, et al.: Molecular basis of the K:6,-7 [Js(a+b-)] phenotype in the Kell blood group system. *Transfusion* 1995; 35: 822-5.

7. PMID: 9426633 — Lee S, Naime DS, Reid ME, et al.: Molecular basis for the high-incidence antigens of the Kell blood group system. *Transfusion* 1997; 37: 1117-22.

8. PMID: 9354821 — Lee S, Naime D, Reid M, et al.: The KEL24 and KEL14 alleles of the Kell blood group system. *Transfusion* 1997; 37: 1035-8.

9. PMID: 9269063 — Lee S: Molecular basis of Kell blood group phenotypes. *Vox Sang* 1997; 73: 1-11.

10. PMID: 8837356 — Jongerius JM, Daniels GL, Overbeeke MA, et al.: A new low-incidence antigen in the Kell blood group system: VLAN (KEL25). *Vox Sang* 1996; 71: 43-7.

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Antigens of the Kel System

KEL antigens encoded by reference sequence

antigens obsolete

001 K	002 k	003 Kpa	004 Kpb	005 Ku	006 Jsa	007 Jsb	008 …	009 …	010 Ula	011 K11	012 K12	10
013 K13	014 K14	015 …	016 K16	017 K17	018 K18	019 K19	020 Km	021 Kpc	022 K22	023 K23	024 K24	11
025 VLAN	026 TOU	027 RAZ	028 VONG	029 KALT	030 KTIM	031 KYO	032 KUCI	033 KANT	034 KASH	035 KELP	036 KETI	12
037 KHUL	038 KYOR	039 KEAL										3

total KEL antigens: 36

Track of changes		**from v4.0 160701**	**to v5.0 25-FEB-2020**
	created:	Masja de Haas	Barbera Veldhuisen
	reviewed:	n.a.	Christoph Gassner
General		Last word version published on ISBT website	First Excel map version. Spread-sheets "Intro", "Allele Table", "References", and "Versioning" created.
Intro	Tekst changed	32 antigens	36 antigens
Intro	Tekst changed	n.a.	Text added: "The protein links via a single disulfide bond to the XK membrane protein that carries the Kx antigen. Absence of XK leads to a reduction of expression of Kell antigens on the red blood cell membrane."
Intro	LRG ID line added:	n.a.	LRG_799
Intro	LRG sequence added:	n.a.	NG_007492.2 (genomic), NM_000420.2 (transcript) NP_000411.1 (protein)
Intro	Antigen number for reference allele	Reference allele 21 antigens	KEL13, KEL16 and KEL21 added to reference allele on basis of their character as high frequency antigens (to be verified)
Intro	Reference allele line moved from Allele Table to Intro:	Reference allele 21 antigens	Reference allele line moved from Allele Table to Intro: reference allele with 24 antigens: KEL2, KEL4, KEL5, KEL7, KEL11, KEL12, KEL13, KEL14, KEL16, KEL18, KEL19, KEL20, KEL22, KEL26, KEL27, KEL29, KEL30, KEL32, KEL33, KEL34, KEL35, KEL36, KEL37, KEL38
Intro	Antithetical Antigens line created in Intro:	n.a.	[KEL1 KEL2]; [KEL3 KEL4 KEL21]; [KEL6 KEL7]; [KEL11 KEL17]; [KEL14 KEL24]; [WT KEL25 KEL28]; [KEL31 KEL38]; [KEL37 KEL39]

Track of changes		**from v4.0 160701**	**to v5.0 25-FEB-2020**
Intro	Low frequency antigen line created in Intro		KEL3, KEL6, KEL10, KEL17, KEL21, KEL23, KEL24, KEL25, KEL28, KEL31, KEL39 (extra line created since low frequency antigens KEL10 and KEL23 were missing in Intro)
Allele Table	Table column and header additions	n.a.	Table columns "(Reference No.) PMID" created and content added and column "Accession number" and "rs-number" updated
Allele Table	Antigen/allele added:	n.a.	*KEL*01.03* added
Allele Table	Antigen/allele added:	n.a.	*KEL*02.39* added
Allele Table	Antigen/allele added:	n.a.	*KEL*02.40* added
Allele Table	Antigen/allele added:	n.a.	*KEL*01N.03* added
Allele Table	Antigen/allele added:	n.a.	*KEL*02N.30* to *KEL*02N.54* added
Allele Table	Antigen/allele added:	n.a.	*KEL*01M.02* to *KEL*01M.06* added
Allele Table	Antigen/allele added:	n.a.	*KEL*02M.12* to *KEL*02M.18* added
Allele Table	Remark added	n.a.	*KEL*02N.26* and *KEL*02N.02* same null mutation (no expression of Kel antigens). Allele in cis with Jsa and Jsb respectivily.
End of changes		**from v4.0 160701**	**to v5.0 25-FEB-2020**