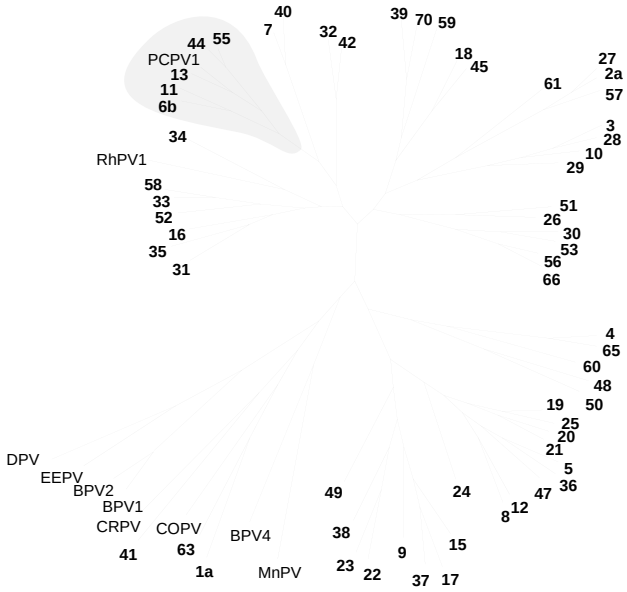
Group A10 Sequences

HPV6 HPV11
HPV13 HPV44
HPV55 PCPV1



INTRODUCTION

Group A10 includes several of the old group B viruses with the addition of the Pygmy Chimpanzee papillomavirus (PCPV-1). It consists of human papillomavirus types 6, 11, 13, 44, and 55, viruses primarily associated with orogenital lesions with low oncogenic potential, and PCPV-1. Lorinz et al. classified HPV-6, HPV-11 and HPV-44 as “low risk” viruses [1]. DNA from these three viruses and others in the low-risk class was detected in 20.2% of the low-grade cervical lesions, in 4.2% of the high-grade lesions, and in none of the 153 invasive cancers screened [1].

Many researchers view HPV-6 and HPV-11 together as a functional group [1]. These two viruses are primarily responsible for the benign HPV infection of the anogenital tract. Condylomata acuminata have been shown to harbour HPV-6 or HPV-11 DNA in more than 93% of the cases [1]. Conversely, relatively few HPV-6 and HPV-11 positive genital malignancies have been identified despite extensive international screening. In the IBSCC worldwide investigation of over 1000 cervical tumors, a single HPV-6 and a single HPV-11 were identified [2]. Two cases containing HPV-55 were also identified in this study. One type of malignancy, although rare, is strongly correlated with HPV-6 and HPV-11 infection: Buschke-Lowenstein tumors, the highly differentiated squamous cell tumors of the genital region, are associated almost exclusively with HPV-6 and HPV-11 [3,4]. HPV-44 and HPV-55 have been detected in condyloma acuminata of the genital region (vulvar and penile, respectively) [5,6].

The strong association of HPV-6 and HPV-11 with certain types of genital carcinomas (vulvar and vaginal) appears to be inconsistent with their classification as low-risk. Several explanations have been proposed to explain this anomaly. First, Lorincz et al. suggest the limited number of papillomavirus probes available to researchers may have contributed to the false-positive identification of HPV-6 and HPV-11 [1]. Second, researchers have shown a correlation between oncogenic potential and the presence of a duplicate upstream regulatory region in the genome. A species of HPV-11 with this duplication has been shown to transform baby rat kidney cells and such duplications have been found in carcinomas harbouring HPV-11 and HPV-6 DNA [7–10]. However, alterations in the URR should be considered with caution since rearrangements have been observed following amplification of cloned genomes [11]. Recent investigations suggest that rearrangement of the HPV-6b URR occurred during propogation in *E. coli* [12]. Rubben et al. suggest that cellular and environmental factors following infection may induce this duplication event and/or other rearrangements leading to acquired oncogenic properties [10]. Cofactors which may contribute to malignancy include alcohol and tobacco use and sexual intercourse during menstrual periods [13, 14].

In addition to their involvement with anogenital tract lesions, HPV-6, HPV-11 and HPV-13 are strongly associated with ororespiratory tract infection. In one study, 72% of all laryngeal papillomas and 25% of all oral papillomas were positive for HPV-6 and HPV-11 DNA [15]. HPV6 and HPV-11 have been detected in benign papillomas infecting almost every epithelial lining of the upper digestive and respiratory tracts. These tissues include the larynx, sinonasal area, lung,

tonsil, tongue, and linings of the oral cavity [7, 15–17]. Unexpectedly, a high percentage (60%) of laryngeal carcinomas have been shown to be positive for HPV-11 DNA [18]. HPV-13 was reported by de Villiers to be present in 13% of all oral papillomas [15]. Specifically, HPV-13 has been highly correlated with oral focal epithelial hyperplasia (FEH), a benign lesion situated primarily on the mucosae of the lower lips and cheeks [19]. This disease is frequently found among Indians in Central and South America and in Eskimos in Greenland and Alaska [19]; the prevalence among Caucasians in the same area is much lower [19]. HPV-13 has also been detected in a case of low-grade cervical dysplasia and in Bowenoid papulosis in an HIV-positive male [19].

Several subtypes of HPV-6 have been identified. Subtype 6a has been isolated from tonsillar carcinoma, lung carcinoma and Buschke-Lowenstein tumors [9,16,20]. The complete genomic sequence of HPV-6a has recently been reported (GenBank accession L41216) [21]. As this variant is so similar to the sequence we published last year (HPV-6b) we have chosen not to print it in hard copy form but to make it available on our World Wide Web site (see Part V). HPV-6b, the prototypical HPV-6 subtype, was initially cloned and sequenced from a benign genital wart [22]. It has been subsequently detected in various genital and upper digestive and respiratory tract lesions. The HPV-6c genome was molecularly cloned from both a respiratory-tract papilloma and a condyloma acuminatum of the cervix [23]. This subtype has also been detected in benign laryngeal papillomas and benign nasopapillomas [24]. The HPV-6d genome, cloned from Buschke-Lowenstein tumors, contains a tandem duplication of 459 base pairs in the noncoding region of the genome [16]. HPV-6e was identified in a genital wart and laryngeal papillomas [23–25]. HPV-6f has been cloned from a benign laryngeal papilloma and a non-inverted nasal papilloma [24, 26]. HPV-6vc was cloned from a rapidly growing vulvar verrucous carcinoma [27]. And, finally, a worldwide study of sequence variation in the HPV-6 and HPV-11 URR demonstrating the phylogenetic spectrum of these viruses has been reported [11]; it is perhaps worth noting that the levels of sequence diversity observed in this study are more consistent with considering HPV-6a and HPV-6b to be variants rather than distinct subtypes.

With the release this year of sequences for HPV-44 and HPV-55, complete genomic sequences are now available for all members of Group A10. We consider HPV-11 and HPV-6b to be "close types"—sequences which qualify to be distinct types under the criterion of ten percent dissimilarity at the nucleotide level, but between which most of the changes are "silent", causing no difference at the amino acid level *Human Papillomaviruses 1994* (Part III). The Pygmy Chimpanzee papillomavirus (PCPV-1), which in last year's compendium was included in the old group "I," is close enough to HPV-13 for these to be considered "close types." A sequence related to PCPV-1 has been identified in a buccal scrape from a chimpanzee (*Pan troglodytes*; like the reference sequence, the variant is more similar to HPV-13 than many HPV types are to each other [28].

What's new?

The complete genomes of HPV-44 and HPV-55 are the only new sequencs in Group A10 released during 1995. The sequences of other members of this group were published in *Human Papillomaviruses 1994* pp. I-B-5, I-B-10, and I-B-14.

References

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HPV44

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LOCUS       HPV44        7833 bp    DNA             VRL       18-JUL-1995
DEFINITION  Human papillomavirus type 44, complete genome.
ACCESSION   U31788
KEYWORDS    .
SOURCE      Human papillomavirus type 44.
REFERENCE   1  (bases 1 to 7833)
  AUTHORS   Delius,H.
  JOURNAL   Unpublished, Sequenced by Hajo Delius, Deutsches
            Deutsches Krebsforschungzentrum, Angewandte Tumorvirologie,
            I.N.F. 506, W-6900 Heidelberg, Germany
REFERENCE   2  (bases 1 to 7833)
  AUTHORS   Farmer,A.D.
  TITLE     Direct Submission
  JOURNAL   Submitted (18-JUL-1995) Andrew D. Farmer, HIV Sequence Database,
            Los Alamos National Labroatory, T-10, Mail Stop K710, Los Alamos,
            NM 87501, USA
COMMENT     HPV-44 is a mucosatropic HPV which to date has not been detected in
            cervical cancer. Prevalence studies indicate that HPV-44 and HPV-43
            have been found in 4% of cervical intraepithelial neoplasms, but in
            none of the 56 cervical cancers tested (Lorincz et al, J. Virol 63,
            2829-2834). During the analysis of approximately 1000 anogenital
            tissue samples, two new HPV types, HPV-43 and HPV-44, were
            identified. The complete genome of HPV-44 was recovered from a
            vulvar condyloma and cloned into bacteriophage lambda. The biopsy
            was taken from a woman from the Detroit Michigan area. The DNA
            recovered was a single 7.8 kb BamHI fragment. A possible feature of
            HPV types associated with malignant lesions is the potential to
            produce a different E6 protein by alternative splicing. This
            potential has been found in types HPV-16, HPV-18, and HPV-31.
            HPV-44 has a potential E6 splice donor at nt 229, but does not
            contain a potential splice acceptor.  Phylogenetic analysis
            indicates that HPV-44 is most closely related to HPV-55, HPV-6,
            HPV-11 and HPV-13.
BASE COUNT     2383 a   1545 c   1678 g   2227 t
ORIGIN      105 bp upstream from beginning of E6 cds
        1 ttaataataa tctaaccttt acaaaaaaga ggaggaACCG AATTCGGTtc caACCGAAAA
                                      E2 binding ->     E2 binding ->
       61 CGGTTATATA Aaaaccagcc caaaaattaa gcaagcgggg cataATGgaa agtgcaaatg
         E6 orf start ->                          E6 cds ->
       signal ->
      121 cctccacgtc tgcacaaagt atagaccagt tgtgcaagga gtgcaacatt cctatgcaca
      181 atctgcaaat tttatgcgtg ttttgcagaa aaacgttaag tactgcagag gtttattcat
      241 tcgcatataa acagttatat gtagtgtacc gaggaaactt tccatttgca gcctgtgcca
      301 tttgtttaga actacaaggt aaggtcaatc aatttaggca ttttaactac gcgggatatg
      361 cagtaacagt ggaagaagaa acaaataagt caattctgga cgtgctgata cgctgctatt
      421 tgtgccacaa accattgtgc cacgtggaaa aggtgcgcca catattggac aaggcgcgat
      481 tcatTAAatt acaagatACC TGGAAGGGTc gctgcttcca ttgttggaca tcATGcatgg
    E7 orf start ->         -> E2 binding                   E7 cds ->
      541 aaactatact acctTAAagg aaattgtttt acagctggaa cctcctgacc ctgtaggcct
                           <- E6 end
      601 acattgcaat gagcaattag acagctcaga agatgaggtg gatgaactag ccacgcaagc
      661 cacgcaagac gttacacagc cttaccaaat agtaACCACC TGTGGTacat gTAGtcggaa
                                    E2 binding ->       E1 orf start ->
      721 ggttcggctg gttgtgcagt gcacaggaac agacatccat cacctacata cgcttctgct
      781 gggttcactg gatatattgt gtcctgtgtg tgcgcccaaa accTAAcaac gATGgctgac
                                                        <- E7 end
                                                         E1 cds ->
      841 aatacaggta cagagggaac gggatgctca ggatggtttc tagtagaggc tatagtggag
      901 aacacaaccg ggcaacaaat atcagaggat gaggatgagg cagtggagga tagtgggttg
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 961 gatatggtgg actttataga tgacaggcct attacacaca attccatgga agcacaggca
1021 ttgttaaacg agcaggaggc ggatgctcat tatgcggctg tgcaggacct aaaacgaaag
1081 tatttaggta gtccatatgt tagtccttta agtaatattg agcaggcagt ggagtgtgac
1141 attagcccac ggctggacgc tataacatta agtagacaac caaaaaaagt aaagcgacgg
1201 ctgtttgaca gaccagaatt aacggacagt ggatatggca atactgaagt ggaagctgaa
1261 acgcaggtag agagaaatgg cgaaccggaa gattgtgggg gaggtggaca aggaagggac
1321 acagaggggg tggaacaggt ggaaacggaa gtgcagacac atagcaacac acaacagcac
1381 accgggacca cgcgggtact agaactattg aaatgtaaga atataagggc tacactgctt
1441 ggtaagttta aggattgcta tgggttatca tatacagatt taattagaca atttaaaagt
1501 gacaagacaa catgtgggga ctgggtaatt gcagcctttg gggtgcacca tagtgtgtca
1561 gaggcgtttc aaaatttaat acagccagta acaacatata gccacataca atggcttaca
1621 aatgcatggg gaatggtcct actggcatta gtaaggttta aggtaaataa aaacagatgt
1681 acagtggcac gtatgatggc aacccgttta aatatacctg aggaccacat gttaattgaa
1741 cctcctaaaa tacaaagcgg tgttgcagcg ttatattggt ttagaagtgg tatatccaat
1801 gccagtatag taactggaga aacaccggaa tggataacaa ggcaaaccat tgtagaacat
1861 gggcttgcag acaaccaatt taaattagca gacatggttc aatgggcata tgataatgac
1921 ttttgtgagg aaagtgaaat tgcatttgaa tatgcacaac gtgcagatat agatgccaat
1981 gccagagcat tcctaaatag taattgtcag gcaaaatatg taaaagactg tgccacaatg
2041 tgcaagcact ataaaactgc agaaatgaaa aaaatgaata tgaaacagtg gataaaattt
2101 aggagcagta aatttgaaga cacaggaaat tggaaaccaa tagtgcaatt tttaagacac
2161 caaaacatag aatttattcc gtttttaact aaattaaaga tgtggctgca tggtacacca
2221 aaaaaaaact gtattgcaat agtgggccca ccagacacag gtaaatcgtg tttttgtatg
2281 agtttaatta aattcttagg aggcactgta attagttatg taaactccag cagtcacttt
2341 tggctacagc ccttatgcaa tgcaaaagta gcattattag atgatgtaac ccaatcctgc
2401 tgggtatata tggatacata tatgagaaac ctattagatg gaaaccctat gaccattgac
2461 agaaaacaca aatcattagc attaataaaa tgtccgcctt taatagtaac atcaaacata
2521 gacattacta aagaagagaa atacaaatat ttatgtagca gggtaacatt atttacattt
2581 ccaaatccat tccccctttga cagaaatggg aatgcactat atgacctgtg tgaaacaaac
2641 tggaaatgtt tctttgcaag attatcatca agtcTAGata tacaaacatc agaggacgag
                               E2 orf start ->
2701 gacgATGgag acaatagcca agcatttaga tgtgtgccag gaacagttgt tagaactgta
  E2 cds ->
2761 TGAagaaaat agtaataaac ttacaaaaca tatacaacat tggaaatgta tacgatatga
      <- E1 end
2821 atgtgtgtta ctacacaaag ctaagcaaat gggcctgaac cacattggaa tgcaagtggt
2881 gccagcatta gcagtgtcac agacaaaggg acaccaggca attgaaatgc aaatgacatt
2941 agaaacatta ctaaactctg actatggtac ggaaccatgg acattgcaag agacaagtcg
3001 ggaaatgtgg ttaacaccac ccaaatattg ctttaaaaag cagggacaaa ctgtggaagt
3061 aaaatttgac tgcaatgcag acaatgcaat ggagtatgta tggtggaaag tcatttatgt
3121 atttgacaca gacaaatggg taaaagtgac aggacacaTA Gactataaag ggttgtatta
                                  E4 orf start ->
                                  NH2 terminus unknown
3181 tgtacatggt gggcataaaa cctattatac aaattttgaa aaggaggccg aaaaatatgg
3241 gaactcttta caatgggagg tatgtattgg cagcagtatc atatgttctc ctgcatctat
3301 atctagtact gtgcaagacg tatccattgc tgggcctgct tcacactcct cctcctccac
3361 caccaccacc cttgcacagg cctcatccac actgcccatt ggcaccgccg aggactgcgt
3421 ggacgcgccg ccatgtaaac gaccccgagg acccccccaca aacaccaaca acgccagaaa
3481 caccgtctgt gtcagaaaca gcgactccgt ggacagtaca aacaacaaca tcctccctaa
3541 cagttacaac agtaacaaag gacgggacaa caattattgt acagctacgc ctgTAGttca
                                                                <- E4 end
3601 attacaaggt gatgctaatt gtttaaagtg tttaagatat agattacatg caaagtataa
3661 aacattgttt gtagcagcat cgtccacatg gcgctggaca tgttcagata catccagtaa
3721 tgcactggta acattaacat atgttgatga acagcaacgc cagcagtttt taaacactgt
3781 aaagttacca ccaaaagtta catataaagt tggatatatg tctttacaat tgttaTAAtg
                                                                  <- E2 end
3841 tgtgttgtat atatcTAAtt gtatatattg tacATGgaac acatacctat agatgctact
          E5 orf start ->        E5 cds ->
3901 ataggggcaa ccagcacatc attactgcca gttgtaattg ccctgtttgt atgctttgtt
3961 agcattgtat taattatttg tatttctgat tttatagtgt acacatctat attggtacta
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HPV44

```
4021 accttactgc tatatctgtt actttggctt ttactaacct ctgccctgca attttattta
4081 ctaacactgt gtgtctgctt ttttcctgcg tggtatatac atttccatat tgtacataca
4141 caacaagaaT AActattaca atgctaacat gtacgtttga tgatggtgat acatggctgt
                <- E5 end
4201 tattgtggtt gttattaaca ttaattgtta ccattatagc attgttatta atgcatttaa
4261 aaactgtaca atgcgttaca tgcagTAAat aagtatttgt atatttggtg tgtattgTAT
                      L2 orf start ->                       signal ->
4321 AAAtATGgca cacagtaggg cacgtagacg taaacgtgca tctgctaccc aattatatca
  L2 cds ->
4381 aacatgtaag gctgcaggca cctgtccctc tgatattatt cctaaggtgg aacataacac
4441 tattgcagat cagatATTAA Agtggggcag tttgggggtt ttttttgggg gactggggat
             signal ->
4501 tggtacaggc tctggcacag gcggtagaac agggtatata cctttacaat ccaccccgcg
4561 tcctgacatt ccctctgtac ctaccgcaag gccacctata cttgttgata ctgttgcacc
4621 tggggacccg tccattgtat ccttggttga agaatctgct attataaatt cgggggcccc
4681 ggaattggtc cctccttccc atgcaggatt tgaaatcact acatctgaat ctaccacacc
4741 agctatatta gatgtgtctg tcaccacaca tactacctct acaagtgtat ttaaaaaccc
4801 tagctttgct gacccatctg ttgtacagtc gcagcctgct gttgaagctg gtggccacat
4861 acttatctct acctcatcta tatcgtccca ccctgtagaa gaaatacctt tggatacatt
4921 tatagtatct tcctctgata gtaatcctgc atctagcact cccattccag catctggtgc
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5041 ctttttgtcc tctccccagc gcctaataac atttgataat cctgcatatg aaggggagga
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5281 tttctatcaa gacatttctc ctatatctgc tgctgcagaa gaaatagaac tgcacccccc
5341 tgtggccact gcacaggata gtggcctgtt tgatatttat gcagaacctg accctgatgt
5401 tacagaagaa cctgtttcat tgtctttttc tacctccaca ccctttcagc ggtcttctgt
5461 gtcagccacc ccatggggca atactactgt ccctctttca ttacctgctg acatgtttgt
5521 acagcctggt cctgacataa tctttcctac tgcatccact acaactccct atagtcctgt
5581 cactcctgct ttacctacag gtcctgtttt taTAAgtggt gctgcatttt atttatatcc
                            L1 orf start ->
5641 tacatggtat tttgcacgca aacgccgtaa acgtgtttcc ttgtttttg cagATGtggc
                                                          L1 cds ->
5701 ggccTAGtga aaaccaggta tatgtgcctc ctcccgcccc agtatccaaa gtaataccta
          <- L2 end
5761 cggatgccta tgtcaaacgc accaacatat attaccatgc tagcagttct agacttcttg
5821 ctgtgggcaa cccttatttt gccatacgac cagcaaacaa gacacttgtg cctaaggttt
5881 cgggatttca atatagggtt tttaagatgg tattgccaga ccctaataaa tttgccttac
5941 ctgacacatc tatatatgac cccactacgc aacgcctggt atgggcctgc atcgggctgg
6001 aggtaggtag aggacagccc ttaggtgttg gtattagtgg gcatccatta ttaaataaat
6061 tggatgatgt agaaaattca gctagttatg cagccggtcc gggtcaggat aacagggtaa
6121 atgtggccat ggactataaa caaacacaat tatgtttggt tggctgtgca cccccgttag
6181 gtgagcattg gggtaaaggc aagcagtgta ataatgttag tgttaaggat ggggactgcc
6241 ctcccttgga attaattact agtgtaattg aggatggtga tatggtggac actggttttg
6301 gagccatgaa ttttgctgaa ttgcagccaa ataaatctga tgttccatta gatatatgca
6361 ctgctacatg taaatatcct gactatttac aaatggctgc agatccatat ggggacagat
6421 tgtttttta cttacgaaag gaacagatgt ttgccagaca ttttttaat agggctggaa
6481 cagttggtga ggacgtttcc caggatctgg ttattaaaag tgctagtaaa aatactgttc
6541 ctaatgctat atactttaat acacccagtg gttctcttgt atcttctgaa acccaattat
6601 ttaataagcc tttttggttg caaaaggcgc agggccacaa taatggtatt tgttggggaa
6661 atcagttatt tgttactgtt gtagatacta cccgtagtac aaacatgaca atatgtgctg
6721 ccactacaca gtcccctccg tctacatata ctagtgaaca atataagcaa tacatgcgac
6781 atgttgagga gtttgactta caatttatgt ttcaattatg tagtattacc ttaacggcgg
6841 aggtaatggc ctatcttcat actatgaatg ctggtatttt agaacagtgg aactttgggt
6901 tgtcgccgcc cccaaatggt accttagagg acaaatacag atatgtgcag tcccaggcca
6961 ttacatgtca aaagccaccc cctgaaaagg caaagcagga ccccctatgca aaattaagtt
7021 tttgggaggt ggatcttaga gaaaagtttt ctagtgagtt ggatcaatat ccccttggta
7081 gaaaattttt attacaaacg ggtgtgcagg cccgttcctc tgttcgtgtg ggtaggaaac
```

```
     7141 gtcctgcgtc tgcagccact tcctccagta aacaaaaacg gtctaggaag aagTAGtatg
                                                                  <- L1 end
     7201 tgttattgtt ttgtttgtat gtgtgtcata tgttattgtg ttatatatgt gttgtgttgt
     7261 atatatgttg tatgtgtatg ttgtgtaatg ttgtctgtaa tggaatgcat gtgtgtgttg
     7321 tacatAATAA Acttaatctg tgtgtcctgt tccaccccat gagtaagtgt tgtagtgttg
        signal ->
     7381 tgttctatgt ttggtatata taatatataa catatgtaca gccatgttag tttttaaaca
     7441 tattcctcca ttttgggtgc aACCGTTTTC GGTtgttcat tttgggtgca ACCGTTTTCG
                     E2 binding ->                   E2 binding ->
     7501 GTtgttactc attacccaca tcctgtaccc aatttgttat agcaagcaaa atatttaatc
     7561 atctctgcca gaactttatt atgttactaa gtacacacct ggcgcacagc taggcgcggt
     7621 ttggcaacta cacaatacat tcctaatctc tatactactg ctgtctcgtt tgtgaacaat
     7681 agtgcgctgg tagccaactt tttaaaagca tttttggcta ctagcactgc atttttgtac
     7741 agttactgtt ggttttataa aatgagtaac ctaaggtcac acacctgcgA CCGGTATCGG
                                                 E2 binding ->
     7801 Ttgacacaca ccctgtacac ttccttatca tag
//
```

HPV55

```
LOCUS       HPV55        7822 bp    DNA             VRL       18-JUL-1995
DEFINITION  Human papillomavirus type 55, complete genome.
ACCESSION   U31791
KEYWORDS    .
SOURCE      Human papillomavirus type 55.
REFERENCE   1  (bases 1 to 7822)
  AUTHORS   Delius,H.
  JOURNAL   Unpublished, Sequenced by Hajo Delius, Deutsches
            Deutsches Krebsforschungzentrum, Angewandte Tumorvirologie,
            I.N.F. 506, W-6900 Heidelberg, Germany
REFERENCE   2  (bases 1 to 7822)
  AUTHORS   Farmer,A.D.
  TITLE     Direct Submission
  JOURNAL   Submitted (18-JUL-1995) Andrew D. Farmer, HIV Sequence Database,
            Los Alamos National Labroatory, T-10, Mail Stop K710, Los Alamos,
            NM 87501, USA
COMMENT     HPV-55 was first isolated from a penile condyloma acuminata. In a
            survey of a large variety of tumours, HPV55 was detected in an
            additional case of condyloma acuminata. Hybridization and
            phylogenetic analysis group HPV-55 with HPV-44, HPV-6, HPV-11, and
            HPV-13.
BASE COUNT     2400 a   1526 c   1658 g   2238 t
ORIGIN      102 bp upstream from beginning of E6 cds
        1 taataataat gtaagcttta gaaaagagga gggACCGAAT TCGGTtccaA CCGAAAACGG
                                    E2 binding ->    E2 binding ->
       61 TTATATAAaa accagcccaa aaattaagca agcggggcat aATGgaaagt gcaaatgcct
     E6 orf start ->                             E6 cds ->
    signal ->
      121 ccacggctgc acaaagtata gaccagttgt gcaaggagtg caacattcct atgcaccatt
      181 tgcaaatttt atgcgtgttt tgcagaaaaa ccttgaccac tgcagaggtt tattcattcg
      241 catataaaca gttatatgta gtgtttcgag gtaactttcc atttgcagcc tgtgccattt
      301 gtttagaact acaaggtaag gtcaatcaat ttaggcattt tgacttcgcg ggatatgcat
      361 taacagtgga agaagagaca aagcagtcaa ttttggacgt gttcatacgc tgttatttgt
      421 gccacaaacc attgtgccac gtggaaaagg tgcgccacat attggagaag gcgcgattta
      481 tTAAattaca gaatACCTGG AAGGGTcgct gcttccattg ctggacatcA TGcatggaaa
 E7 orf start ->         -> E2 binding                  E7 cds ->
      541 ctatcctacc tTGAaggaaa ttgttttaga gctggatcct cctgaccctg taggcctaca
                        <- E6 end
      601 ttgcaatgag caattagaca gctcagagga tgaggtggat gaactagcca cgcaggccac
      661 gcaagacgtt acacagcctt accaaatagt aACCACCTGT GGTacatgTA Accggaacgt
                                E2 binding ->       E1 orf start ->
      721 tcggctggtt gtgcagtgca caggaacaga catctgtcaa ctacatacgc ttctgctggg
      781 ttcactggaa atactgtgtc ctgtgtgtgc gcccaaaaac TAAcaacgAT Ggcagacaat
                                                      <- E7 end
                                                      E1 cds ->
      841 acaggtacag aggggacggg gtgctcagga tggttcttag tagaggctat agtggagaaa
      901 acaactgggc aacaaatatc tgaggatgag gatgaggcag tggacgatag tgggttggat
      961 atggtggact ttatagatga caggcctatt acacacaatt ccatggaagc acaggcattg
     1021 ttaaacgagc aggaggcgga tgctcattat gcggctgtgc aggacctaaa acgaaagtat
     1081 ttaggtagtc catatgtgag tcctttaagc aatattaagg aggcagtgga gtgtgacatt
     1141 agcccacggt tggatgccat aaaattaagt agacaACCCA AAAAGGTaaa gcggcggctg
                                    E2 binding ->
     1201 tttgaaagac cagaattaac ggacagtgga tatggcaata ttgatgtgga agctgaaacg
     1261 caggtagaga gaaatggcga accggaagat tgtgggggag gtggacaagg aagggacaca
     1321 gaggaggggg tggaacaggt ggaaacggaa gtgcagacac atagcgacac acagctgcac
     1381 accgagacca cgcgggtagt agaactgtta aaatgtaaga atatacgggc tacactgctt
     1441 ggtaagttta aggactgtta tgggttatca tatacagatt taattagaca atttaaaagt
     1501 gacaagacaa catgtgggga ctgggtgatt gcagcatttg gggtgcacca tagtgtatcg
     1561 gaggcgtttc aaaatttaat acaaccagta acaacatata gccacataca atggcttaca
```

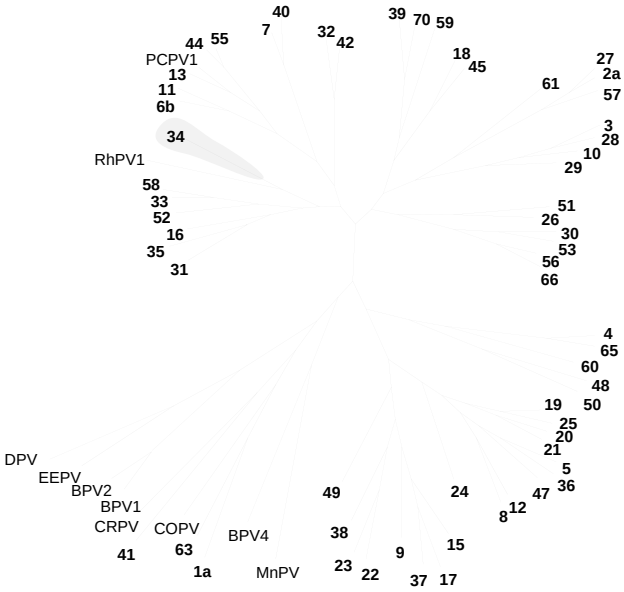
```
1621 aatgcatggg gaatggtatt actggcatta ttacggttta aggtaaataa aaacagatgt
1681 acagtggcac gcatgatggc aacacgttta aatatacctg aggatcatat gttaattgaa
1741 cctcctaaaa tacaaagcgg tgttgcagca ttatattggt ttagaagtag tatatccaat
1801 gccagtatag ttactggaga aacgcctgaa tggataacaa ggcaaaccat tgtagaacat
1861 gggcttggtg acaaccaatt caaattaaca gaaatggtgc aatgggcata tgataatgac
1921 ttttgtgagg aaagtgaaat tgcatttgaa tatgcacaac gtgcagatat agatgcaaat
1981 gcaagagcat ttttaaatag taattgtcag gcaaaatatg taaaagattg tgctacaatg
2041 tgcaagcact ataaaactgc agaaatgaaa aaaatgagta tgaaacagtg gataaaattt
2101 aggagcagta aatatgaaga aacaggcaat tggaaaccaa tagttcaatt tttaagatat
2161 caaaatattg aattcattcc atttttaact aaattgaaaa tgtggctgca tgggacacct
2221 aaaaaaaact gtattgcaat tgtaggacca ccagacacag ggaaatcgtg tttctgtatg
2281 agtttaatta aatttttagg aggcactgta attagttatg taaactctag tagtcacttt
2341 tggctacagc ccctatgcaa tgcaaaagta gcattgttag acgatgtaac acaatcgtgc
2401 tgggtatata tggatacata catgagaaac ctattagatg gaaaccctat gactattgac
2461 agaaaacaca aatcattagc attaataaaa tgtccgccat taatagtaac atctaacata
2521 gacattacta aagaagataa atataaatat ttatgtagca gggtaacatt atttacattt
2581 ccaaatccat tccccctttga cagaaatggg aatgcactat atgacctgtg tgaatcaaac
2641 tggaaatgtt tctttgcaag attatcaaca agtcTAGata tacaaacatc tgaggacgag
                              E2 orf start ->
2701 gacgATGgag acaatagcca agcatttaga tgtgtgccag gaacagttgt tagaactgta
  E2 cds ->
2761 TGAagaaaat agtaataacc ttacaaaaca tatacaacat tggaaatgca taagatatga
      <- E1 end
2821 atgtgtgtta ttacacaaag caaagcaaat gggcctaaac cacattggaa tgcaagtggt
2881 gccagcatta acagtgtcac agacaaaggg acaccaggcc attgaaatgc aaatgacatt
2941 agaaacacta ttaaactctg actatggtat ggaaccatgg acattgcaag acacaagtcg
3001 tgaaatgtgg ttaacagcac ccaaatactg ttttaaaaaa cagggacaaa ctgtggaagt
3061 aaaatatgac tgcaatgcag acaacattat ggagtatgta tcgtggaaat atatttatgt
3121 gcatgacaca gacaaatggg taaaagtgac aggacacaTA Gactataaag ggttgtatta
                                  E4 orf start ->
                                  NH2 terminus unknown
3181 tgtacatggc gggcataaaa cctattatac caattttgaa aaagaggcta aaaaatatgg
3241 gaactcatta caatgggagg tctgtattgg tagcagtgtc atatgttctc ctgcatctat
3301 atctagtact gtgcaagacg tatccattgc tgggcctgct tcacacacct cctcctccac
3361 caccaccacc cttgcacagg cctcacctgc actgcccacc tgcacctccg aggaacgcgt
3421 ggacccgccg ccatgtaaac gaccccgagg acccaccaca aacaccaaca acgccaggga
3481 caccgtcagt gtccgacaca gcgactccgt ggacagtaca aacaacaaca tctaccctaa
3541 cagttacaac agtaacaaag gacgggacaa caatttttgt acagctacgc ctgTAGttca
                                                              <- E4 end
3601 attacaaggt gatcctaatt gtttaaagtg tttaagatat agattacatg caaagcataa
3661 aacattgttt gtagcagcat cgtccacatg gcgctggaca tgttcagata cttccagtaa
3721 acatgcactg gtaacattaa catatgttaa tgaagagcaa cgtgagcagt ttttaaacac
3781 tgtacggtta cctccaacag ttacatataa agttggatat atgtctttac aattgttaTA
3841 Atgcttattg tatatattTA Attgtataaa ttgtacATGg aacatatacc tatagatggt
    <- E2 end  E5 orf start ->       E5 cds ->
3901 actatagggg caaccagcac atcattactg ccagttgtac ttgccctgtt tgtatgtttt
3961 gttagcattg tattaattat ttacatttct gattttatag tgtacacatc tatattggta
4021 ctaaccttac tgctatatat gttactttgg cttttactaa ccactgccct gcaattttat
4081 gtactaacac tgtgtgtctg ctttttttcct gcgtggtatc tacatttcta tattgtacat
4141 acacaagaaT AActattaca atgctaacat gtacctttga tgatggtgat acatggttgt
                <- E5 end
4201 tattatggtt tatattaacc ttaattgtta ccattgtggc attgttatta atgcacttta
4261 aatctgtacc atgtgttaca tgcagTAAat aagtgtttgt aaacgtggtg tggttggtat
                      L2 orf start ->
4321 aattATGgca cacagcaggg cacgtagacg taaacgtgcc tcagctaccc aattatatca
  L2 cds ->
4381 aacctgtaag gctgcaggca cctgtccatc tgatattatt cctaaagttg aacataacac
4441 tattgctgat caaatATTAA Agtggggcag tttgggtgtt ttttttggag gactgggaat
             signal ->
```

```
4501 tggtacaggc tctggcacag gtggtcgaac aggatatatt cctttgcaat ctaccccacg
4561 tcctgagatt ccctctggcc ctaccacaag gccacctata cttgttgata cagttgcacc
4621 tggtgacccc tctattgttt ctttggttga agaatctgct attataaatt caggagctcc
4681 ggaattggtc cctccgtccc atggtggctt tgagattact acatcagaat ccaccacacc
4741 agccatatta gatgtgtctg ttacaacaca tactacctct acaagtgtat ttagaaaccc
4801 tagctttgca gacccatctg ttgtacagtc ccagccagcc gttgaagctg gtggacacat
4861 acttatctct acctcaacca tatcgtccca ccctgtagag gaaataccat tagatacatt
4921 tatagtatct tcttcagata gtaatcctgc atctagcact cccattccag catctggtgc
4981 acgaccacgt attggcctat acagtaaggc tttacaccag gtacaggtaa cggatcccgc
5041 ctttttgtcc tctccccaac gccttataac atttgataat cctgcatatg aaggggaaga
5101 tgttagtttg gagtttgcac acaatactat acatcagcct ccagatgatg cgtttatgga
5161 tattatacga ttgcacagac cagctataca atctcggcgt ggtcgtgtgc ggtttagtag
5221 aataggacaa cgggggtcta tgtacacacg tagtggtaaa catattggtg gcaggataca
5281 tttctatcaa gacatatctc ctatatctgc tgctgcagaa gaaatagaac tgcaccctct
5341 tgtggccact gcacacgata ctagcctgtt tgatatttat gcagaacctg accctgactt
5401 tacagaagaa cctgttccat tgtctttttc cacctccacg ccctttcagc ggtcttctgt
5461 gtcagccacc ccatggggca atactactgt ccctctttca ttacctggtg acatgtttgt
5521 acagcctggt cctgacataa tatttcctac tgcatccact acaactccct atagtcctgt
5581 cactcctgct ttacctacag gtcctgtttt taTAAgtggt gctacatttt atttatatcc
                            L1 orf start ->
5641 tgcatggtat tttgcacgca aacgccgtaa acgtgtttcc ttgtttttg cagATGtggc
                                                      L1 cds ->
5701 ggccTAGtga aaaccaggta tatgtgcctc ctcccgcccc agtatccaaa gtaataacta
         <- L2 end
5761 cggatgccta tgtcaaacgc accaacatag tttaccatgc tagcagttct agacttcttg
5821 ctgtaggcaa cccttatttt gccatacgac cagcaaacaa gacacttgtg cctaaagttt
5881 caggatttca atatagggtt tttaaggtgg tattgccaga ccctaataaa tttgcattac
5941 ctgacacatc tatatatgac cctactacgc aacgcctggt atgggcctgc attgggttgg
6001 aagtgggtag aggccagccc ctgggtgttg gtattagtgg gcatccatta ttaaacaaat
6061 tggatgatgt ggaaaattct gctagttatg cagccagtcc aggtcaggac aacagggtaa
6121 atgtggccat ggactataaa caaacacaat tatgtttagt tggctgtgca cccccattgg
6181 gggagcattg gggtaagggc aagccatgta ataatggtag tgtaaatagc ggagactgcc
6241 ctcccctgga attaattact agtgttatcg aagatggtga tatggtggac actggttttg
6301 gagccatgaa tttcgctgaa ttgcaaccaa ataaatctga tgttccctta gatatatgca
6361 ctgctacatg caaatatcct gactatttac aaatggctgc tgatccatat ggggacagat
6421 tgtttttta cttacgaaag gaacaaatgt ttgcaagaca ttttttaat agggcgggaa
6481 cggttggaga ggacattcca caggatttgg tttttaaagg tgctactaaa agtacagttc
6541 ctaatgccat atactttaat acacccagtg ggtctcttgt atcttctgaa acccaattat
6601 ttaataagcc tttttggttg caaagggcgc agggccacaa taatggtatt tgttggggga
6661 atcagttatt tgttactgtt gtagatacta cacgtagtac aaacatgaca atatgtgctg
6721 ctacaactca gtctccatct acaacatata atagtacaga atataaacaa tacatgcgac
6781 atgttgagga gtttgactta cagtttatgt ttcaattatg tagtattacc ttaactgctg
6841 aggtaatggc ctatttacat accatgaatc ctggtatttt ggaacagtgg aactttgggt
6901 tgtcgccacc cccaaatggt accttagaag acaaatacag atatgtgcag tcacaggcca
6961 ttacatgtca aaagcctccc cctgaaaagg caaagcagga cccctatgca aaattaagtt
7021 tttgggaggt agatctcaga gaaaagtttt ctagtgagtt agatcaatat ccccttggta
7081 ggaaattttt attgcaaacg ggtgtgcagg cccggtcctc tgttcgtgtg ggtagaaaac
7141 gtcctgcatc tgcagccact tcatcctcca gtaaacccaa acggtctagg aagaagTAGt
                                                                  <- L1 end
7201 atgtgttatt gttttgtttg tgtatgtgtg tcatatgtta ttgtttgtta tatgtgttgt
7261 attgtatata tgttgtatgt ctatgttgtg taatgttgta tgtatgcatg tgtgtgttgt
7321 atttAATAAA cttaatctgt gtgtcctgtt ccaccccatg agtaagtgtt gtagtattgt
  signal ->
7381 gtgttatgtc tggtgtatac aatatacaac atatgtacag ccatgttgtt ttataaaaca
7441 catttttaaa catattcctc catttgggt gcaACCGTTT TCGGTtgtta ctcatcaccc
                            E2 binding ->
7501 acatcctgta accaatttgt tgtagcaagc aaaatattta atcttatcta tagttgccaa
7561 aactttacta tgttactaag tacacacctg gcgcacagct aggcgcggtt tggcaactac
7621 acaatacatt cctaatctat ataacactgc tgtctacttg tttaacaatc gtgtgctggt
```

```
     7681 agccaacttt taaaagcatt tttggctact aacactacat ttttgtacag ttactgttag
     7741 ttttataaaa tgagtaacct aaggtcacac acctgcaACC GGTATCGGTt gaaacacacc
                                       E2 binding ->
     7801 ctgtacattt ccttattata gt
//
```

Group A11 Sequences

HPV34 HPV64
HPV73/MM9



INTRODUCTION

Group A11 is made up of three viruses (HPVs 34, 64, and 73) formerly placed in old Group B. It is a group primarily associated with orogenital lesions of low oncogenic potential. The reference clone of HPV-73 has not been released as of this writing, however, the sequence HPVMM9, treated in last year's compendium, has been found to be a variant of HPV-73.

These viruses have been predominantly linked to anogenital lesions. HPV-34 was initially isolated and cloned from a squamous cell carcinoma of Bowen's type and subsequently detected in a genital intraepithelial neoplasia and periungual Bowen's disease [1]. A study which probed lesions with Bowen's disease and squamous cell carcinomas for HPV-34 DNA, reported only one case of positive hybridization, indicating that HPV-34 infection of this nature is relatively rare [1]. HPV-64, a recently identified virus, was cloned and isolated from a vulvar intraepithelial neoplasia [2]. MM9 was derived from a genital swab specimen. Initial prevalence data for MM9 is similar to that obtained for characterized "intermediate-risk" viruses [3]. It was observed in 6 cancers (0.6%) in the IBSCC study [4], where it is referred to as PAP 238a.

What's new?

No new sequences in Group A11 were released during 1995. The sequences of members of this group were published in *Human Papillomaviruses 1994* pp. I-B-19, 26, 27, and I-I-37.

References

[1] Kawashima,M., Jablonska,S., Favre,M., Obalek,S., Croissant,O., and Orth,G. Characterization of a new type of human papillomavirus found in a lesion of Bowen's disease of the skin. *J Virol* **57**:688–92 (1986)

[2] de Villiers,E.M. Human pathogenic papillomavirus types: an update. in *Human pathogenic papillomaviruses*, edited by Harald zur Hausen, Springer-Verlag, Heidelberg, 1994, pp 1–12

[3] Manos,M.M., Waldman,J., Zhang,T. Greer,C., Eichinger,G., Schiffmann,M., and Wheeler, C. Epidemiology and partial nucleotide sequence of four novel genital human papillomaviruses. *J Infect Dis* **170**:1096–99 (1994)

[4] Bosch, F.X., Manos, M.M., Munoz, N., Sherman, M., Jansen, A.M., Peto, J., Schiffman, M.H., Moreno, V., Kurman, R., Shah, K.V., International Biological Study on Cervical Cancer (IBSCC) Study Group. Prevalence of human papillomavirus in cervical cancer: a worldwide perspective. *J Natl Cancer Inst* **87**:796–801 (1995)

Isolated “A” Sequences

CgPV **CP8061**
HPV-54 **LVX82**
MM7

This set of viruses contains supergroup A taxa that do not cluster with any groups within that supergroup.

HPV-54 and CP8061 primarily infect genital mucosa. HPV-54 was isolated from a penile Buschke-Lowenstein tumor in conjunction with HPV-6 DNA. Initial prevalence data indicates that it is a rare genital HPV type [1]. CP8061 was isolated from a cervical lavage sample obtained through clinical studies conducted in the state of New Mexico among a tri-ethnic population [2].

LVX82, which differs by only a few nucleotides from HPVMM7, was isolated from an Amazonian Indian population [3]. HPVMM7 was identified through studies conducted in the state of California. Initial prevalence data for MM7 are similar to those obtained for characterized “intermediate risk” viruses [4]. All samples were obtained from cervical lavages or genital swabs. LVX82/MM7 was detected once (0.1%) in the IBSCC study [5].

What’s new?

My0911 fragments of the four human viruses CP8061, HPV-54, LVX82, and MM7 were published in *Human Papillomaviruses 1994* on pages I-F-45, I-F-40, I-E-12, and I-E-13, respectively. The complete genome of HPV-54 has become available in the past year and is published here in its entirety. The novel Colobus monkey papillomavirus (CgPV), is represented by two partial sequences, CgPV1L1 and CgPV1E1, on the following pages.

References

[1] Favre,M., Kremsdorf,D., Jablonska,S., Obalek,S., Pehau-Arnaudet, G., Croissant, O., and Orth,G. Two new human papillomavirus types (HPV54 and 55) characterized from genital tumours illustrate the plurality of genital HPVs. *Int J Cancer* **45**: 40–46 (1990)

[2] Peyton,C.L., and Wheeler,C.M. Identification of five novel human papillomaviruses in the New Mexico triethnic population. *J. Infect. Dis.* **170**:1089–92(1994)

[3] Ong,C.-K., Bernard,H.-U., and Villa,L.L. Identification of genomic sequences of three novel human papillomaviruses in cervical smears of Amazonian Indians. *J. Infect. Dis.* **170**:1086–88(1994)

[4] Manos,M.M., Waldman,J., Zhang,T. Greer,C., Eichinger,G., Schiffmann,M., and Wheeler, C. Epidemiology and partial nucleotide sequence of four novel genital human papillomaviruses. *J Infect Dis* **170**:1096–99 (1994)

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LOCUS       HPV54        7759 bp ds-DNA             VRL       04-SEP-1995
DEFINITION  Human papillomavirus type 54.
ACCESSION   U37488
SOURCE      Human papillomavirus DNA.
REFERENCE   1  (bases 1 to 7759)
  AUTHORS   Delius,H.
  TITLE     Direct Submission
  JOURNAL   Unpublished, Sequenced by Hajo Delius, Deutsches
            Deutsches Krebsforschungzentrum, Angewandte Tumorvirologie,
            I.N.F. 506, W-6900 Heidelberg, Germany
COMMENT     HPV-54 was first isolated from a patient with condyloma acuminata.
BASE COUNT     2326 a   1530 c   1718 g   2185 t
ORIGIN      102 bp upstream from beginning of E6 cds
        1 taactacaac catgatttat aaaataaggg agggACCGAA AACGGTtcaA CCGAAACCGG
                                    E2 binding ->   E2 binding ->
       61 TacaTATAAA Agcggttgta gaaaacagtt atttgggggc aATGtctgct actgaacccc
       signal ->                 probable E6 cds start ->
      121 acacggacca gccgcgtact ctagctgatt tgtgcaaggt atgcaatatt cctatgcata
      181 gtttgcaact tccttgtgcc ttttgcaaga agacggtgtg tacagcagag atttatgcat
      241 ttcaatataa ggacctattt gtggtgtgga gacacggctt tccacatgct gcatgtgcac
      301 tgtgcctaga actgcacggg caaataaatt atagaaggca tcgcgaccgt gcgtgcctgt
      361 gggaaacagt ggaacaagag tgtggaaagc cattggaaga aatatttata aggtgctggc
      421 tgtgccataa acctttgtgc aacgtggaaa agcaacggca cgtagattac aacaggcgat
      481 tccactgtgt tagaggctat tggaagggTA Ggtgtctaca ttgctggaag ccaTAATGca
                              E7 orf start ->                       <- E6 end
                                                                 E7 cds ->
      541 tggaaatgtg gctacaattg aggatatagt ccttgattta aaaccagaac cgtttgacct
      601 gtactgcagg gagcaattag aagactctga tgcagaagat gagacagcag taacacaacc
      661 tgacaaacaa gcatttaagg tgttaagcca gtgtggaggt gtgtgttgta agacagtacg
      721 gctatgtgtg tatagcacgc acacaggcat aagggtactg caggaactgc ttcatcagga
      781 cgcactgcaa aTAGtgtgtc ccacctgtgc ttcacgacta TAAcggcATG gcggataacc
            E1 orf start ->                              <- E7 end
                                                      E1 cds ->
      841 aaggtacaga ggaggagggg actgggtgta atggatggtt ttttgtggaa gcaattgtag
      901 aacgtaaaac aggggatatt atttcagatg atgagcctga ggatgtggag gacagtgggc
      961 ttgatatggt ggactttatt gataatagtg tgtcacaggt agaggggcag gaaaatccac
     1021 aggcattgtt acatgcccaa cagctgcagg cagatgtaga ggcagtgcaa caattaaaac
     1081 gaaagtatat aggcagtccg tatgtaagtc ctgttgcaaa cagcgaaccc tgtgtagaaa
     1141 aggacctaag ccccccggcta ggggctatat ccctaggacg gcggtcagcc aaagccaaac
     1201 gacggctgtt tgataaggcc caaccgccgc caaatggcca tactgacgtg gaagctgcgg
     1261 tggaggtaaa taccgagggg acagatgaaa cagagacaga ccaggtgcag acagtatctg
     1321 gggaaacaac tacagatagc ctaggaaggc agcaaattac agaattaata cataacacaa
     1381 atattcgtgt agcattgttt ggtatgttta aagacctata tggattaagt tttatggacc
     1441 tagcacggcc atttaaaagt gacaaaacag tgtgtaccga ttgggttatt gcagcatttg
     1501 gaatatatca tggtattaca gatggattta aaacattgct agagccacat tgtttgtatg
     1561 gccatatcca atggctaaca tgtaggtggg gcatggtatt attattatta acaagattta
     1621 aatgtggcaa aaacagatta acagtaagta aatgtttagg aatgttatta aatataccag
     1681 aaacccaaat gttaatagat cctccaaaat tacggacgcc tgcagcagct ttgtattggt
     1741 atagacaggg gctgtccaat gcaagtgaaa tatttggtac acccccggaa tggctggcca
     1801 gacaaactgt aattgaatat agcttagcag acagccagtt tgatttatct aaaatggtac
     1861 aatgggcata tgaccataat tatattgatg acagtattat tgccctggaa tatgctaaat
     1921 tagctgatat agatgaaaat gcggctgcct ttctaggaag taattgtcaa gctaagtatg
     1981 taaaagactg tggaacaatg tgtagacatt atataagggc acaaaaaatg caaatgacaa
     2041 tgtcacaatg gattaaacat cgttgtgatt tagtagagga ggaaggtgag tggaaggaaa
     2101 tagtacgatt ccttagatat caacatgtgg attttatatc ttttatgata gcattaaaac
     2161 aatttttaca aggcatacca aaacacaatt gtatattact gtatggacct ccagacacag
     2221 gaaaatctaa ttttgccatg agtttaatta gctttttagg aggtgtagtg ctatcatatg
     2281 ttaattctag tagccatttt tggttagaac ctttggcaga tgccaaaata gctatgctag
     2341 acgatgctac aacacaatgc tggaactata tggacattta tatgcgcaat gcattagatg
```

```
     2401 gcaatcctat gtgctttgat agaaaacatc gagctatggt gcaaacaaaa tgtcctccac
     2461 taatagtgac ctccaacata aatgctagta cagacgacag atggcgctac ctacacagta
     2521 gagtaaaatg tttttgtttt cccaatagat ttccatttga tagtaatgga aaccctgtgt
     2581 atgatttaag taataaaaat tggaaatcat tctttaaaag gtcatggtca cgtttagcgc
     2641 TGAacgacaa cgataacgag gaggaggaga ATGgagaccc tagcaacacg tttagatgtg
E2 orf start ->                    E2 cds ->
     2701 tgccaggaaa ggcttctaga cctataTGAa aaagatagta ataaactaga ggaccaaata
                                    <- E1 end
     2761 gaacattgga aatgcatacg cctggagtgt gcattgcaat acaaagcccg ggaaatggga
     2821 tacaaagtgt tacagcacca ggcactgcct gcacttgctg tgtcaaaggg caaagggcac
     2881 aaggccattg aactgcaact tgcattagag acattgcaaa agacagtata cagcaccgaa
     2941 ccgtggacat tacaggacac atgcctggaa cggtggaatg caccaccaac tggttgctta
     3001 aaaagacgtg gacaaacagt agatgttata tttgatgggc atcaggataa cacaatgcaa
     3061 tatgtaatgt ggggagatat ttattatcaa aactgtgatg gggagggatg gactaaggtg
     3121 tgcagtaata TAGATGcaat gggtatttat tatatggatg cagaacacaa agtgtattat
   E4 orf and cds start ->
     3181 gtggatttta aaaaggaagc atctaagtat ggggaatatg gacagtggga ggtgcgtatg
     3241 ggcagcagca tcatttttc tcctgcatct gtatctagta ccgaagaggc attgtcaata
     3301 tcctctactg gcactgctga acacaccaga ccagccaatt ccacaccacg taccgacaac
     3361 tccacaaaag caatcccgtg cacgccgccg cctagaaaac gagctagagt ctacagcaca
     3421 gaccagcaac cacacagcac ctcagacccc gtgggctgtg acaacgacag gcacatcagt
     3481 gacgataaca acaagaacca aggacggcac acaagtagtg gtgacactac acctaTAGtg
                                                                  <- E4 end
     3541 cactttaaag gtgaacctaa tacattaaaa tgttttaggc aaagaataca aaagtataaa
     3601 catttgtttg aacaagcatc ctcaacatgg cattgggcat gtgtaccagg taccactaag
     3661 aataggggca ttgtaacatt aacctatagt agtgtagaac aaaggcaaca atttttagta
     3721 actgttcgca ttccacctag tatatctatg tcattagggg taatgtcatt aTAAcagata
                                                            <- E2 end
     3781 atcattgtaa agtttgtgat tgtacatact atattgtaaa acaaccagcc aatactgctg
     3841 ctatgtgtat atagtgaggt atgtatggtg agtatggtag tgagtgcatg caggcctgca
     3901 gtgactgagg tgaggtgtgt gtgtaggtgt gtgtagtgta tgcagtaata atgttgtata
     3961 cagtaagttg gttaacatgt tggtttttat tatccatgtt attatggcaa tgtattacaa
     4021 cagcatttac ttttttctt gtagccttta ttctattgtg ggtacctgcc ctgtgtgttt
     4081 atgtgcgcct tgccaggctt cttgaacttg accttcactt tacataaggt gttactgtgc
     4141 acacctactg tggatgccct gtgtaacctg cttaccatag tatAATAAAt attgtgTAGa
                                            signal ->
                                                    L2 orf start ->
     4201 tatatttgtg tattATGgct aaagcaagag ccccacgccg gaaacgtgca tctgcaacac
                  L2 cds ->
     4261 aattatatca aacatgcaag gcctctggca catgcccttc agatgtaatt cctaaggtag
     4321 agggtacaac tatagcagat caaatcctac gatggggcag tatgggcgtg ttttttgggg
     4381 gcttgggaat aggtactggt agtggcacag ggggccgcac agggtatata ccacttggac
     4441 gaccctctac tacccttgaa ccaggtcctc ctgtacgtcc cgcaggggct gtagaaacag
     4501 tagcaccctc tgacccttcc attgtgtctt tagtagagga atctagtgtt gtggatgttg
     4561 gggcaccaac ccctaccatt ccatcacagg gtgggtttga aatagccaca tctagtgatg
     4621 ctacccctgc tatattagat gtcacctcca ctaccacccc tattagggtg tctataacat
     4681 cccatgataa tcctatatat acagagccat cattattaga ccccccccct ccagtacaaa
     4741 tggatggtcg tgttttagta tctacctcta ctttgcaatc gtccactgct gaaaatatac
     4801 ctatggacac ttttataatt atgcaggacc atataggcac aacaactagc acacctatac
     4861 caaggccgcc tgcacgccca cgcttaggtt tatattcccg tgcgttacag caagtgcctg
     4921 tacaggaccc tgccttttta caacagcctt ccagtcttat aacatatgac aatcctgtat
     4981 atgagggtaa cccagatgtt accctacact ttgagcagcc cacaatacat aatgcacctg
     5041 atcccgcctt tatggacata tttgctttac atagaccagc acttacaact cgtaggggggg
     5101 ttgtacgtta tagtagggtg ggcgacaggg ccacattaca cacacgtagt ggcctgcaac
     5161 ttaaacctcg tgtgcatttt tttcaggact taagccctat tgctcatgtc cctgaggaaa
     5221 tagaattaca ccctttaata tctgcaaaca atacaagcat taacaatggt ctttactcag
     5281 atatatatga tgtatatgct gacacagatt ttgctgacac tggtggtttt tcctcttcta
     5341 ctgtttcaca tagttctgta caaacagccc tacaaactac atctatacca tctcagtatg
```

```
      5401 gtaacaccac agttccccTA Actgcctcat cgccatatac acctataccc acatccttta
                        L1 orf start ->
      5461 ggccctcatc aggtcacacc ccatttgttc ccgcacgtcc tatatttcca caaacaccca
      5521 ttgctgttaa tggtggggat ttttacctgc atcctagtta tacttatgta cgcaaacgcc
      5581 gtaaacgttt cccatatttt cttgcagatg gctATGtggc ggccTAGcga aaacaaagta
                                       L1 cds ->           <- L2 end
      5641 tacctgcctc ctaccccagt ttctaaggtt gtcagcacgg atgaatatgt gactcgcaca
      5701 agcatatact atcatgcaag cagctctaga ttattggctg ttggacatcc atattttaaa
      5761 gtacaaaaaa ccaataataa gcaaagtatt cctaaagtat caggatatca atatagggtg
      5821 tttagggtgc aactacctga tcctaataag tttggactgc ctgatcctag tttatataat
      5881 cctgagacac aacgcttagt atgggcatgc acaggtgtgg aggttggtag gggccagcca
      5941 ttgggtcttg gcctaagtgg tcatccatta ttaaataaat tggatgatac tgaaaatgca
      6001 cctaaatatg ttggtgcagg agctgacaat agggaaaatg ttagcatgga ctataaacaa
      6061 acacagttat gtattttggg ctgcacacca cctataggtg aacactgggc taaaggcaac
      6121 ctatgtacac ctaatacatt ggctgctggt gactgtcctc ctttggaatt agtaaattca
      6181 tatatacagg atggtgatat ggtagatata ggatttgggg ctatggattt taaaacccta
      6241 caaacctcaa aaagtgaggt acccccttgat gtagctacct caatttgtaa atatcctgat
      6301 taccttaaaa tggctgcaga ggcatatggg gacagtttat ttttttactt aaggcgggaa
      6361 caaatgtttg ttaggcatat gttaaatagg gcaggtacca tgggtgagcc tgtacctaat
      6421 gacttataca ttaagaaatc ctcaggtaac cttgacagtt ctatttatgc tgcaactcct
      6481 agtggctcta tggtaacatc tgaataccaa atatttaata agccatactg gttacaacgg
      6541 gcccagggtc aaaacaatgg tatttgttgg ggcaatcagg tgtttttaac agttgtagat
      6601 accacccgta gtactaacct aacattgtgt gctacagcat ccacgcagga tagctttaat
      6661 aattctgact ttagggagta tattagacat gtggaggaat atgatttaca gtttatattt
      6721 cagttatgta ccataaccct tacagcagat gttatggcct atattcatgg aatgaatccc
      6781 actattctag aggactggaa ctttggtata acccccccag ctacaagtag tttggaggac
      6841 acatataggt ttgtacagtc acaggccatt gcatgtcaaa agaataatgc ccctgcaaag
      6901 gaaaaggagg atccttacag taaatttaat ttttggactg ttgaccttaa ggaacgattt
      6961 tcatctgacc ttgaccagtt tcccttgggt cgcaagtttt tactacaggc tggcctacgt
      7021 gcacgtccgc gccttcggcc tgtaaagcgt gcagcccctt cctcctctaa gggtacagcg
      7081 cgcaagcgtg ctaaaactaa aaggTAAcag tgttgtatgt tgtgttgtta tgtgttgttg
                                    <- L1 end
      7141 tgtttgtacc ttgtctgtgt gtatgttgtg tatgtattat gttatgtgtg gaatgtttgt
      7201 gtgtcctatt tatgttgtga ctcgtatgtt atatatgttg tatgttttcc tgtattatat
      7261 atAATAAAga ctttggttgc accctatgag taacttttgt gtgatgttgt ttgctacgtg
      signal ->
      7321 cttagtagcc tttacctttt caccttggt gtccattttg tataatctcc attttatata
      7381 accgaaACCG TTTTCGGTtg ctgttggcac taaaactgtg ttttaagcac tttgtatcgt
      E2 binding ->
      7441 acatctaatc ttttgggcgc cgccacatcc tgccctggta gttttgccag cacatctgca
      7501 cacccacaca tttataactg tcagaacaac ttcactttcc attgtgtaaa aacacgccct
      7561 ttgcattcca acattgattt atatattttt tacataataa aacatgctag taggcacata
      7621 ttttagctgt gtaaacttag taagtgcata gttggcaaac taaaacatag gtgtatgcca
      7681 ggtacgtgtc tgtacaacag tgactaattc aggaaACCGA TTTCGGTtgc tcacccatta
                                    E2 binding ->
      7741 tctttttat cattattat
//
```

```
LOCUS       CgPV1E1       202 bp ds-DNA             VRL       23-APR-1991
DEFINITION  Colobus monkey papilloma virus (CgPV-1) gene homologous to HPV-16
            E1 orf, partial cds.
ACCESSION   M64365
SEGMENT     1 of 2
SOURCE      Colobus monkey papilloma virus (CgPV-1) DNA.
REFERENCE   1  (bases 1 to 202)
  AUTHORS   Reszka,A.A., Sundberg,J.P. and Reichmann,M.E.
  TITLE     In vitro transformation and molecular characterization of colobus
            monkey venereal papillomavirus DNA
  JOURNAL   Virology 181, 787-792 (1991)
COMMENT     The CgPV1 genome was isolated from a penile biopsy of a Colobus
            monkey; total length was approximately 7.8 kb.  The isolated DNA was
            inserted into the pUC18 plasmid.  Genomes obtained by E. coli
            replication of the plasmid were analysed by cross-hybridization with
            other PV genomes, restriction digestions, partial sequencing, and
            transformation assays.  The greatest degree of cross-hybridization was
            obtained to HPVs rather than to other animal PVs, with significant
            hybridization under stringent conditions to HPV2a, HPV3, HPV16 and
            HPV18.  The arrangement of the genome is similar to that of other PVs,
            as determined by hybridization to HPV16.  Comparison of DNA sequence
            fragments from the E1 and L1 ORFs again showed CgPV1 to be more
            similar to genital HPV types than to animal PV types.  The greatest
            similarity appears to be to Groups A2 and A4.  Transformation assays
            indicate that CgPV1 is capable of stably transforming NIH 3T3 cells,
            but not C127 nor Vero cells; with respect to the 3T3 cells,
            transformation potential is comparable for CgPV1 and BPV1.
            Restriction digestion fragment sizes suggest that the genome of the
            CgPV1 isolate is integrated into the host's chromosomal DNA and that
            there has been a deletion similar to deletions found in HPV16 and
            HPV18 from cervical cancers.  The transforming capabilities, genetic
            similarity of CgPV to genital HPVs, and apparent integrated and
            deleted state of the genome suggest that CgPV may provide a useful
            model for investigations of HPVs.  An additional, distinct PV
            (CgPV-2) has been isolated from a cutanteous site on another Colobus
            monkey (Kloster et al. Virology 166(1):30-40).
            NCBI gi: 332158
BASE COUNT       67 a     39 c     53 g     43 t
ORIGIN
        1 gatggttcag tggcctacga ccacgatatc acagagagaa tttgggccta tgaatatgcc
E1 cds ->
       61 agattagcgg atgtggatag caatgcagca gcatttttaa acagcaactg ccagGCCAAg
                                                              NF1 bind ->
      121 tatgtaaaag atgcatgtac aatgtgcaga cattataagc gggcagaggc agcccagatg
      181 acaatgtcac aatggataag ct
                           E1 cds ->
//
```

CgPV

```
LOCUS       CgPV1L1       205 bp ds-DNA             VRL       23-APR-1991
DEFINITION  Colobus monkey papilloma virus (CgPV-1) gene homologous to HPV-16
            L1 orf, partial cds.
ACCESSION   M64366
SEGMENT     2 of 2
SOURCE      Colobus monkey papilloma virus (CgPV-1) DNA.
REFERENCE   1  (bases 1 to 205)
  AUTHORS   Reszka,A.A., Sundberg,J.P. and Reichmann,M.E.
  TITLE     In vitro transformation and molecular characterization of colobus
            monkey venereal papillomavirus DNA
  JOURNAL   Virology 181, 787-792 (1991)
COMMENT     The CgPV1 genome was isolated from a penile biopsy of a Colobus
            monkey; total length was approximately 7.8 kb.  The isolated DNA was
            inserted into the pUC18 plasmid.  Genomes obtained by E. coli
            replication of the plasmid were analysed by cross-hybridization with
            other PV genomes, restriction digestions, partial sequencing, and
            transformation assays.  The greatest degree of cross-hybridization was
            obtained to HPVs rather than to other animal PVs, with significant
            hybridization under stringent conditions to HPV2a, HPV3, HPV16 and
            HPV18.  The arrangement of the genome is similar to that of other PVs,
            as determined by hybridization to HPV16.  Comparison of DNA sequence
            fragments from the E1 and L1 ORFs again showed CgPV1 to be more
            similar to genital HPV types than to animal PV types.  The greatest
            similarity appears to be to Groups A2 and A4.  Transformation assays
            indicate that CgPV1 is capable of stably transforming NIH 3T3 cells,
            but not C127 nor Vero cells; with respect to the 3T3 cells,
            transformation potential is comparable for CgPV1 and BPV1.
            Restriction digestion fragment sizes suggest that the genome of the
            CgPV1 isolate is integrated into the host's chromosomal DNA and that
            there has been a deletion similar to deletions found in HPV16 and
            HPV18 from cervical cancers.  The transforming capabilities, genetic
            similarity of CgPV to genital HPVs, and apparent integrated and
            deleted state of the genome suggest that CgPV may provide a useful
            model for investigations of HPVs.  An additional, distinct PV
            (CgPV-2) has been isolated from a cutanteous site on another Colobus
            monkey (Kloster et al. Virology 166(1):30-40).
            NCBI gi: 332159
BASE COUNT       45 a     46 c     61 g     53 t
ORIGIN
        1 aagtatctgg atatcagtat agggtgttcc gtgtgcggct tccagacccc aataagtttg
L1 cds ->
       61 gtttgcccga aggctccctg tataatccag agacccaaag gttagtatgg gcctgccgtg
      121 gggtcgaggt aggtcgtgga cagcctctgg gagttggcac tagtggccat cccttgttca
      181 atagactgga tgacactgag aattc
                               L1 cds ->
//
```